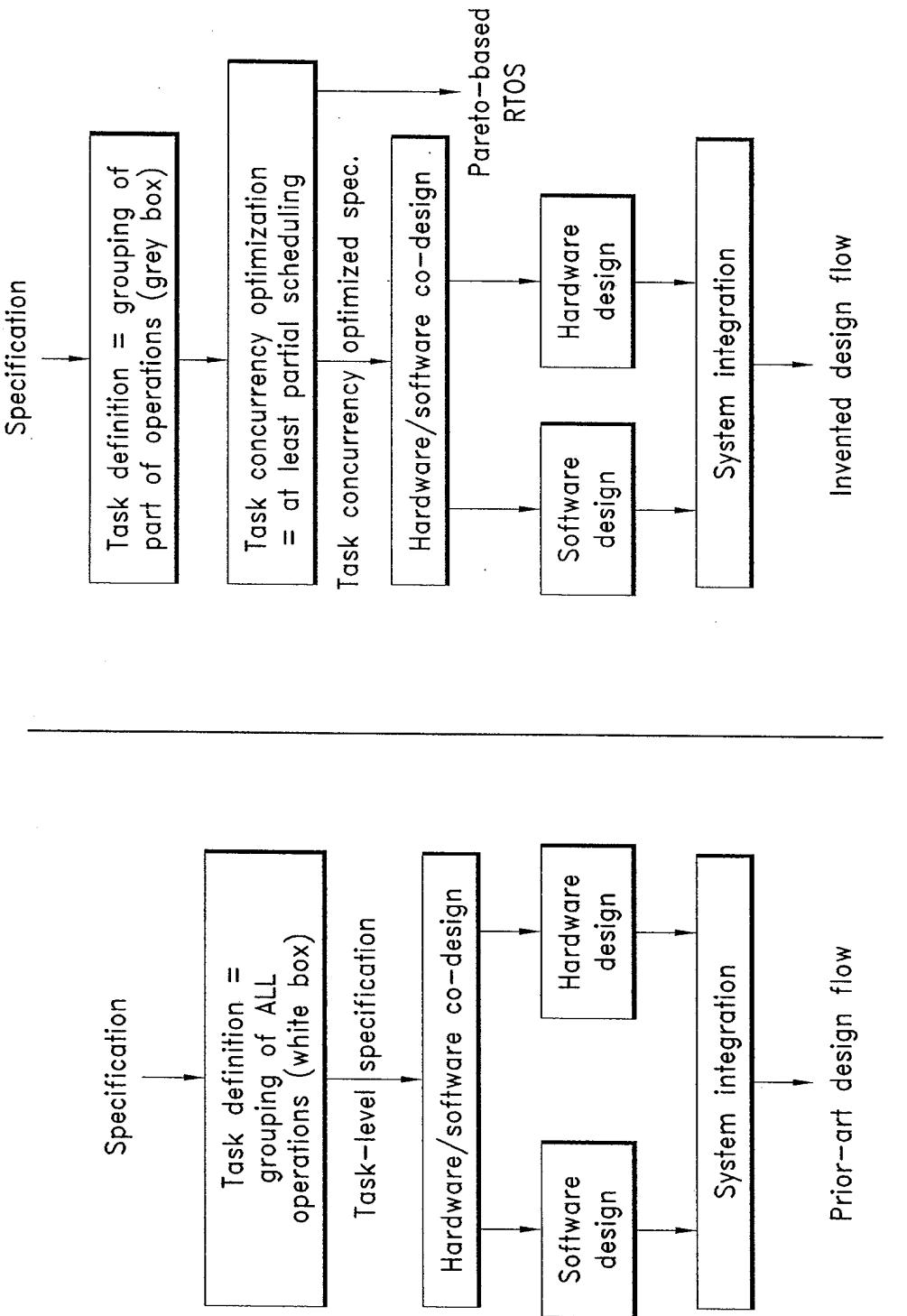


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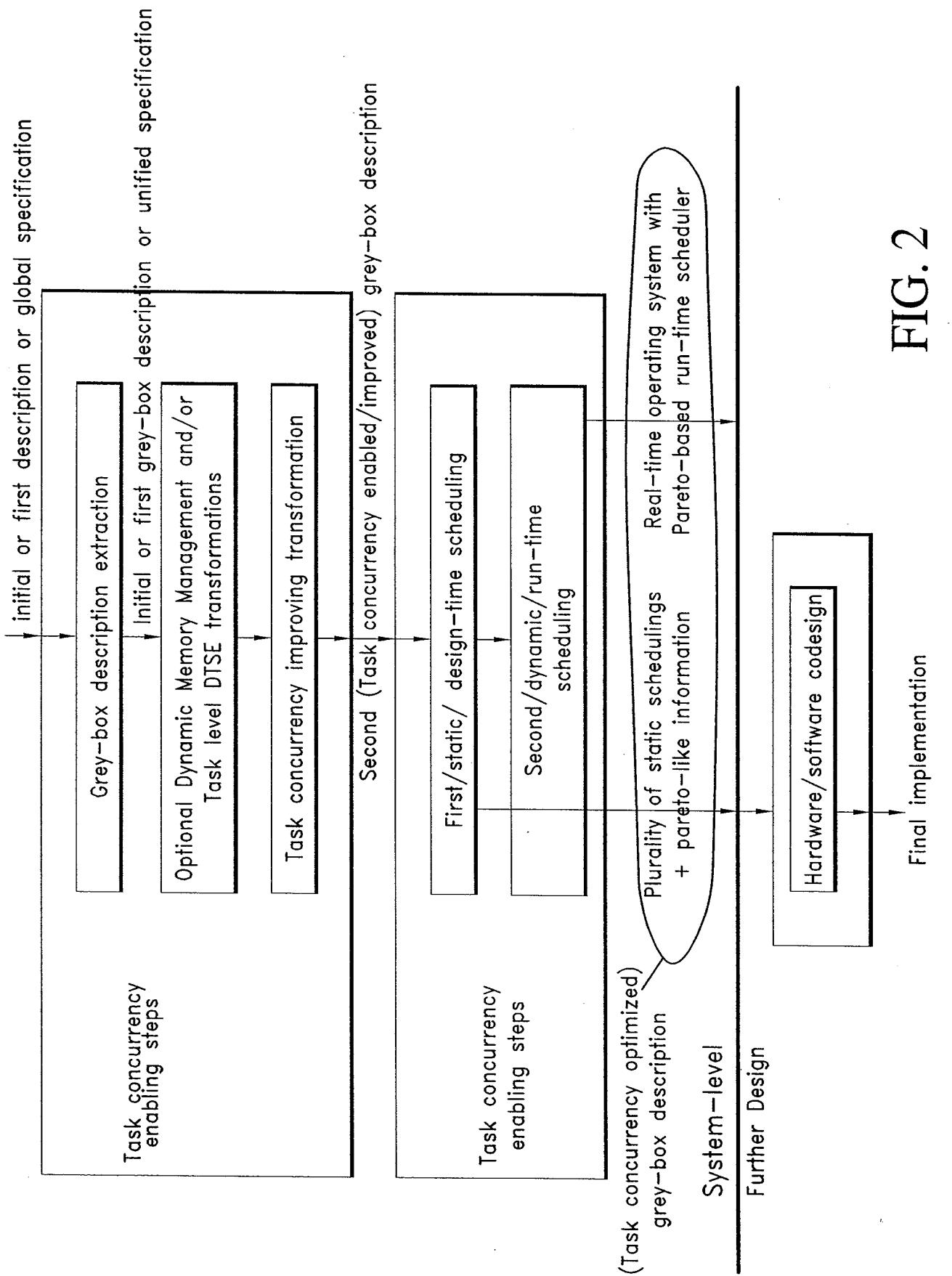
**FIG. 1**  
**(PRIOR ART)**

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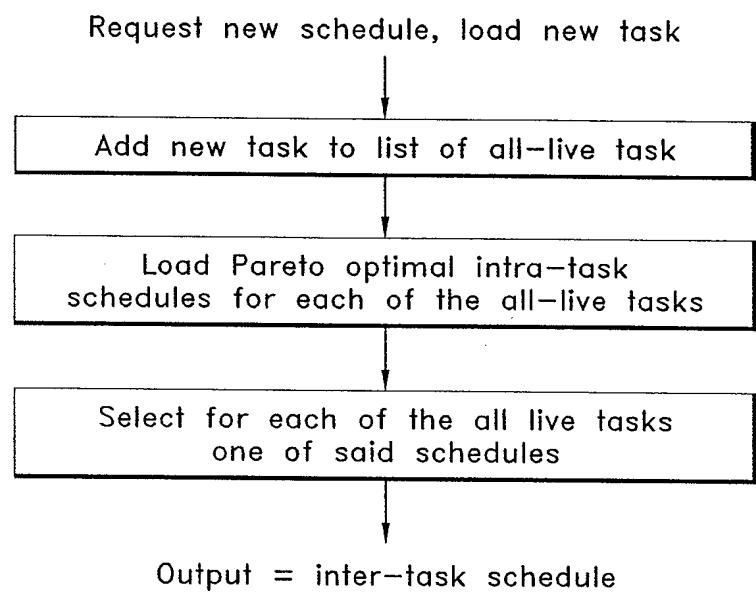
**FIG. 2**

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**FIG. 3**

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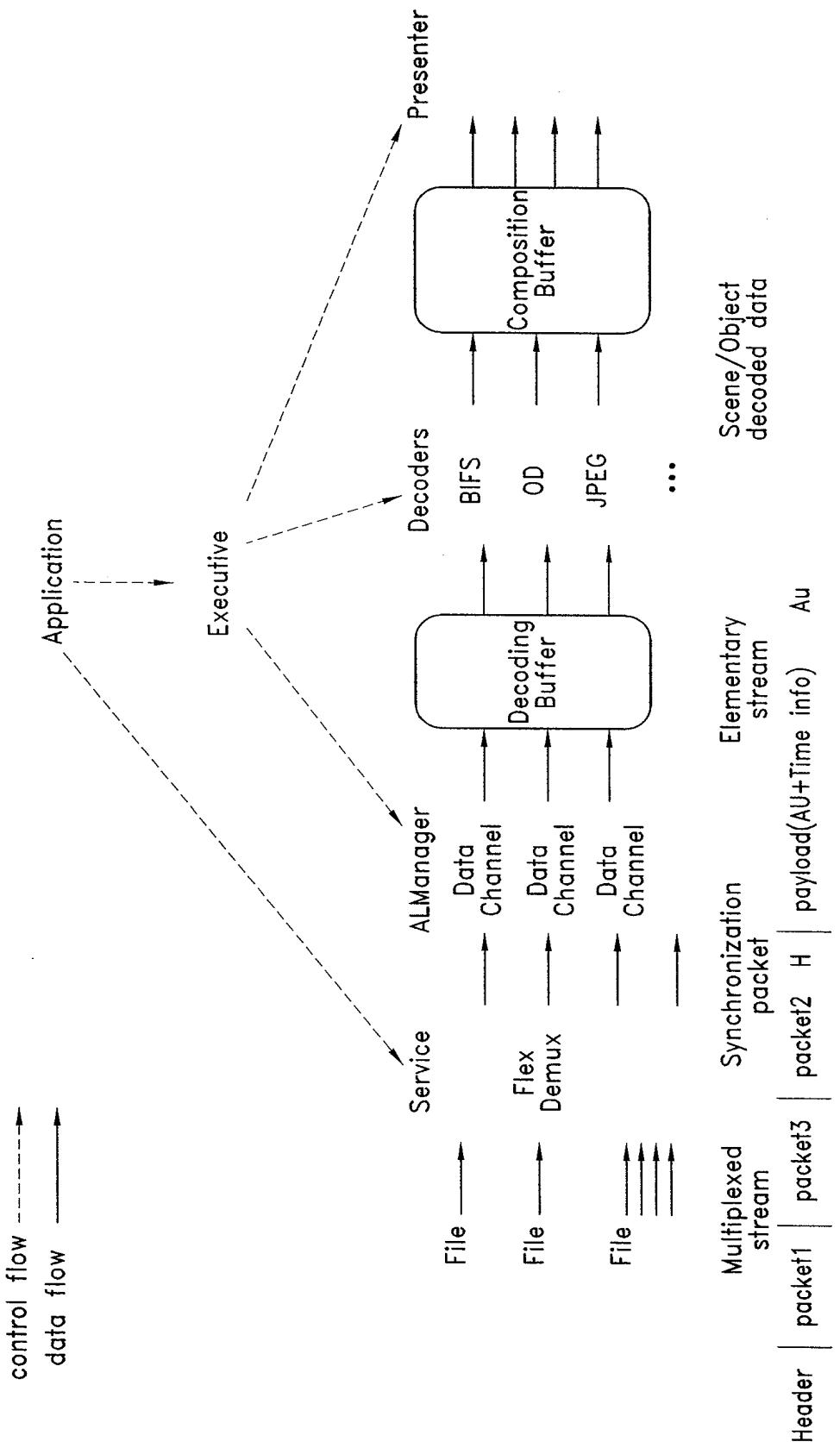


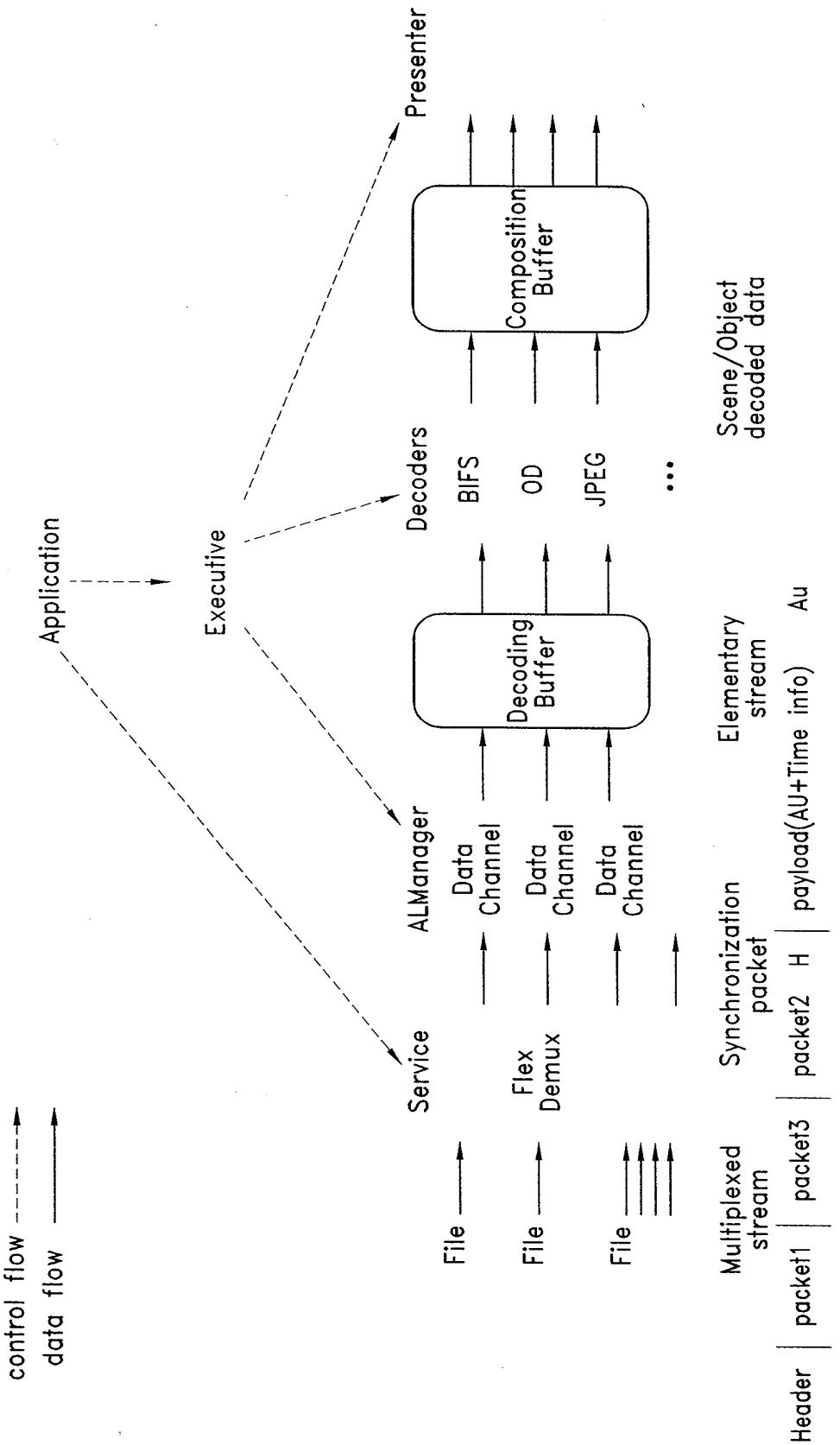
FIG. 4

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**FIG. 5**

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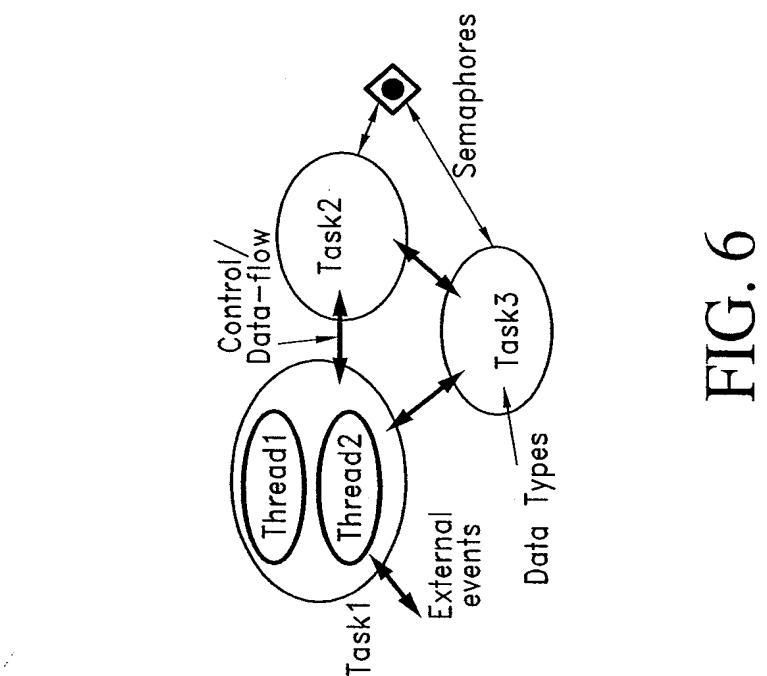


FIG. 6

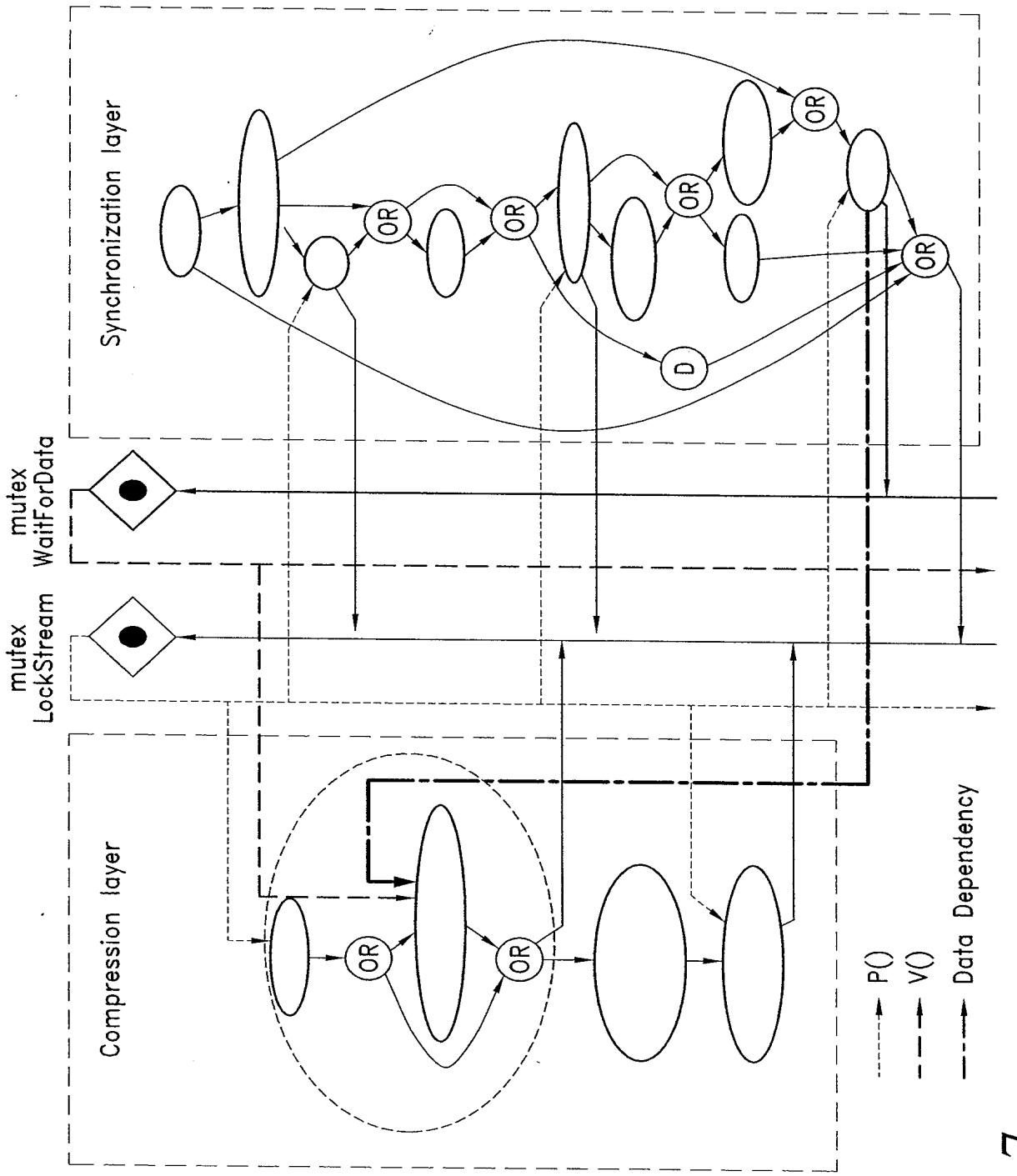


FIG. 7

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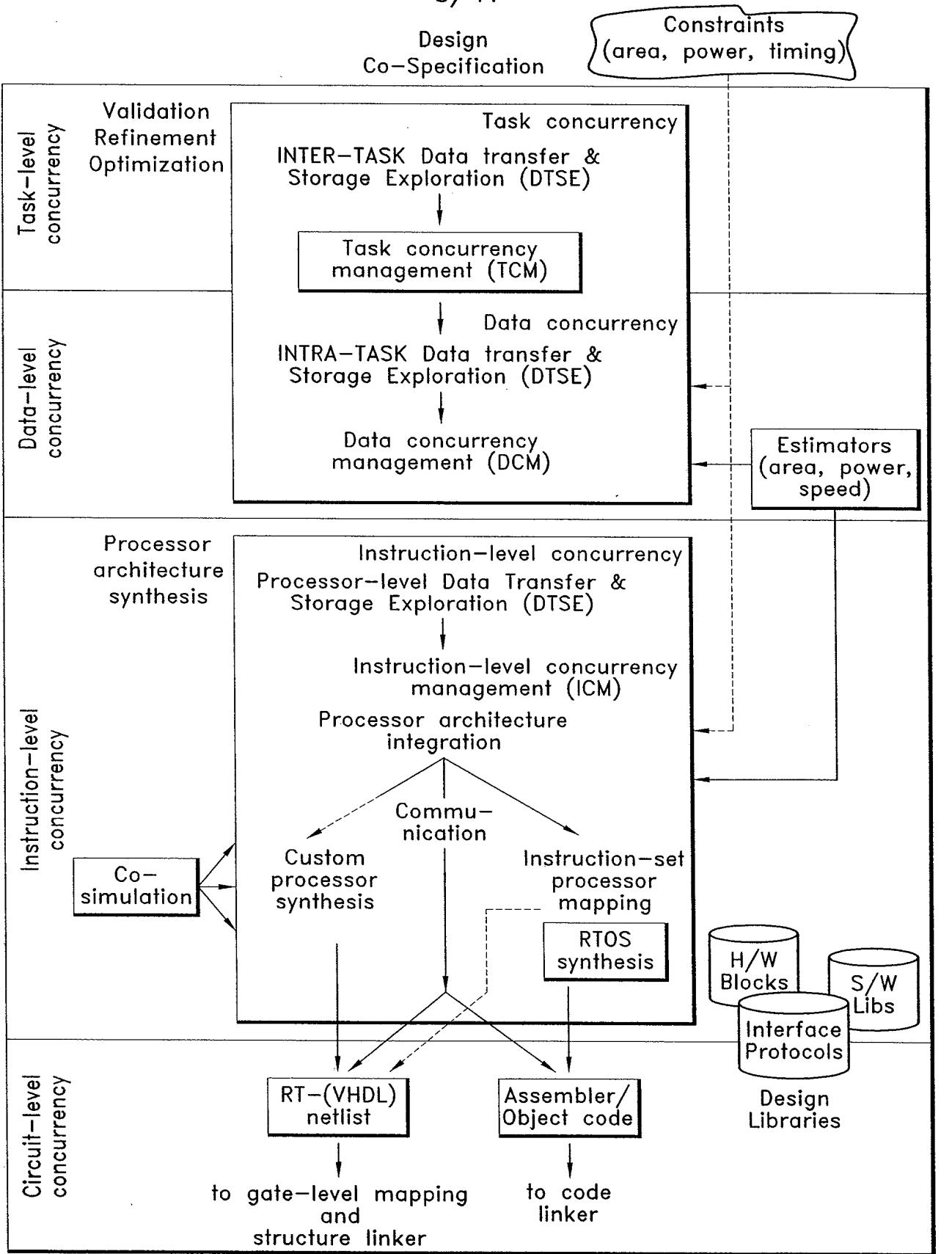


FIG. 8

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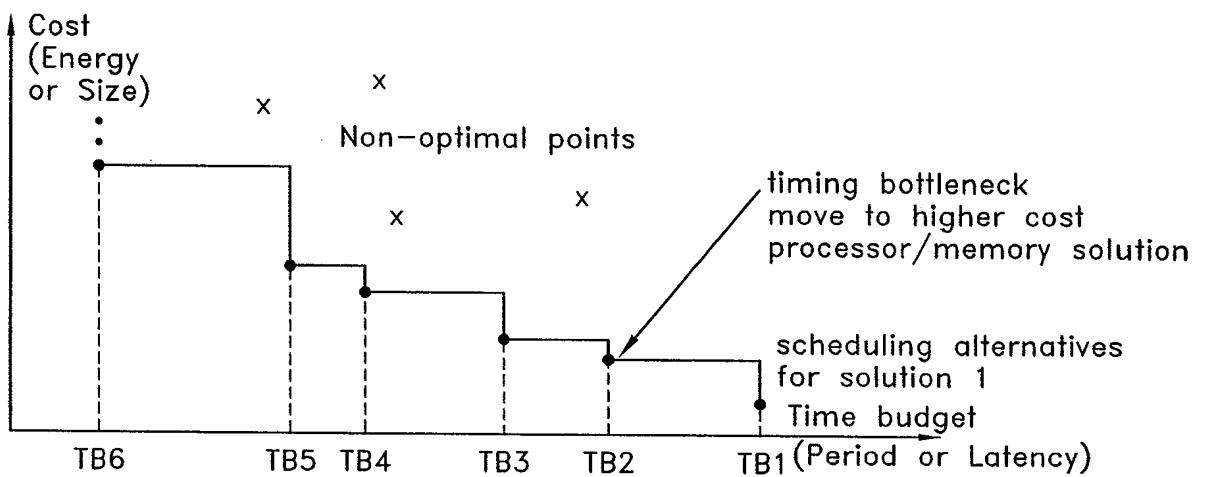


FIG. 9

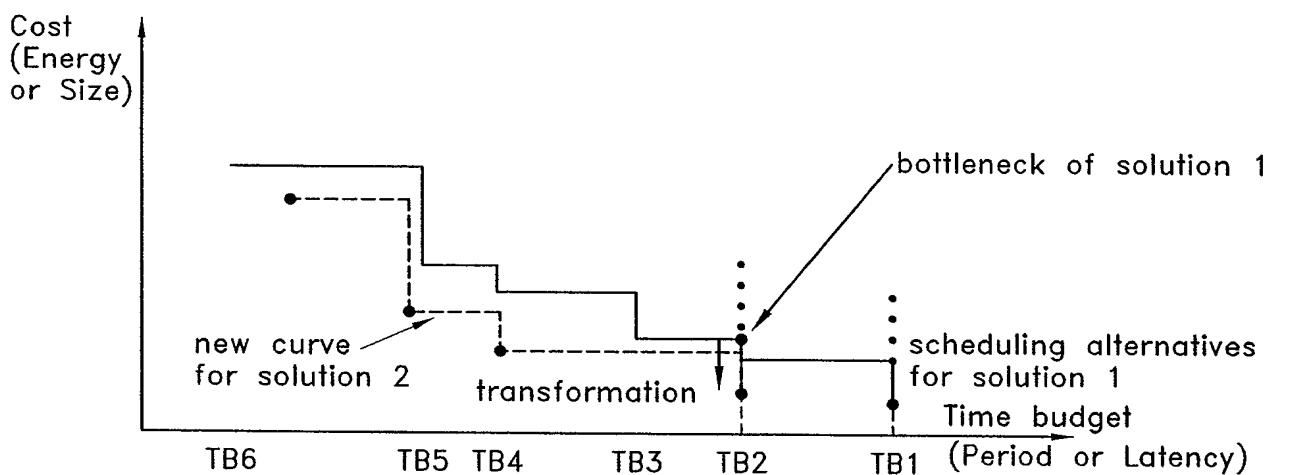


FIG. 10

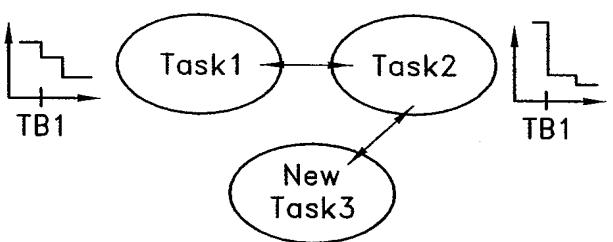


FIG. 11

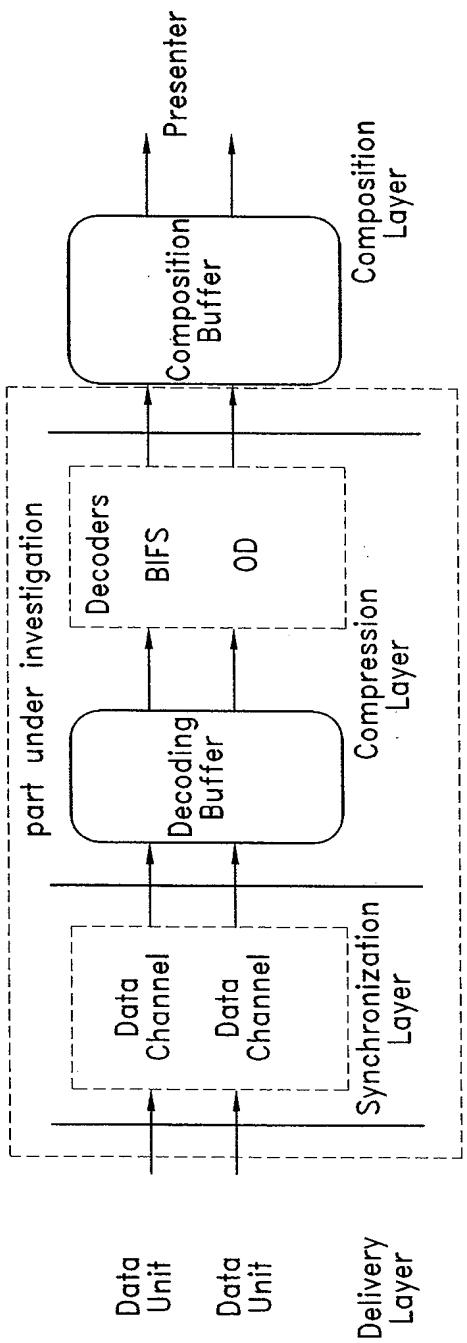


FIG. 12

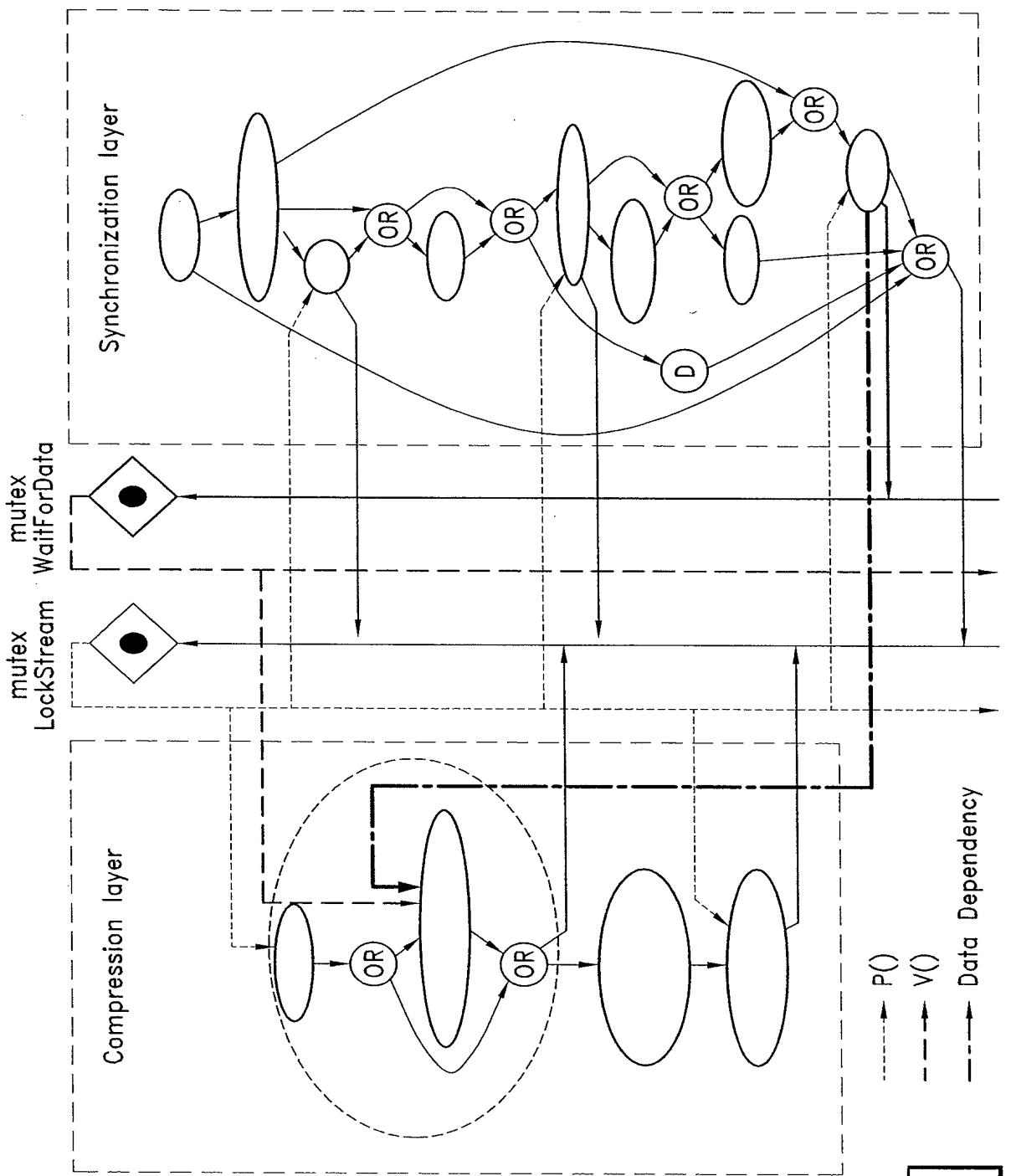
FIG. 13<sub>A</sub>

FIG. 13

FIG. 13 <sub>A</sub>	FIG. 13 <sub>B</sub>
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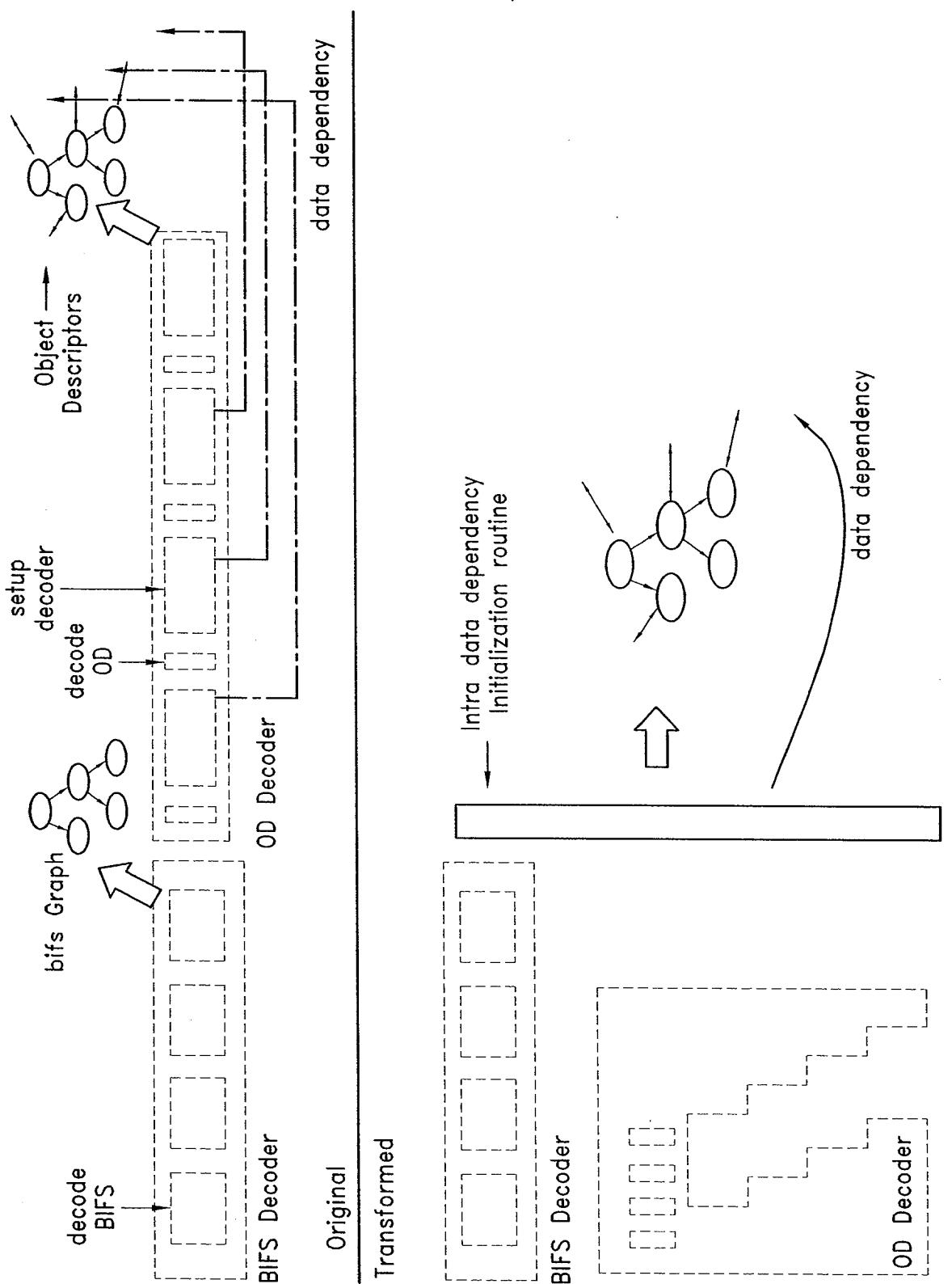


FIG. 13<sub>B</sub>

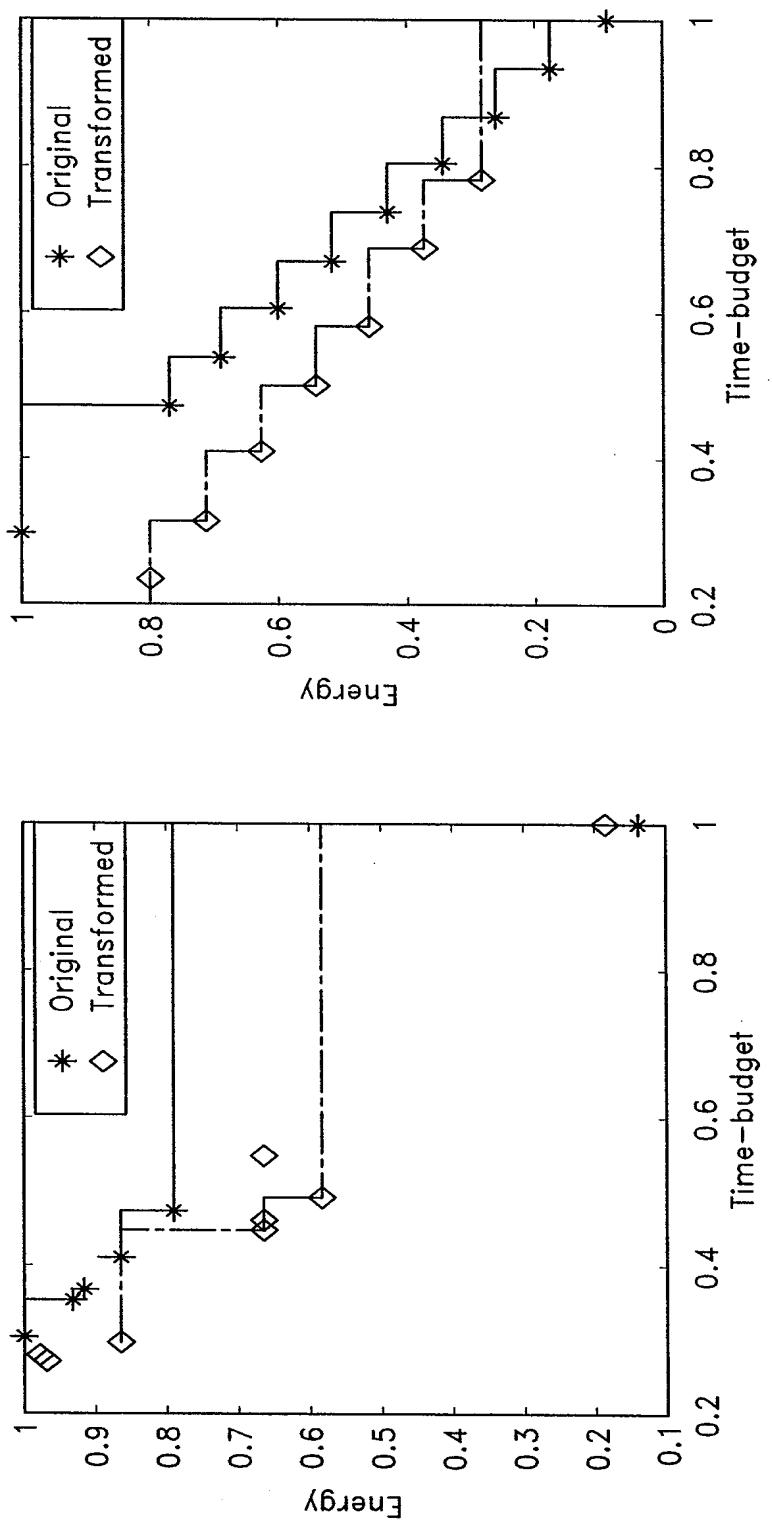


FIG. 14

Hierarchical rewriting hides less important constructs for TCM

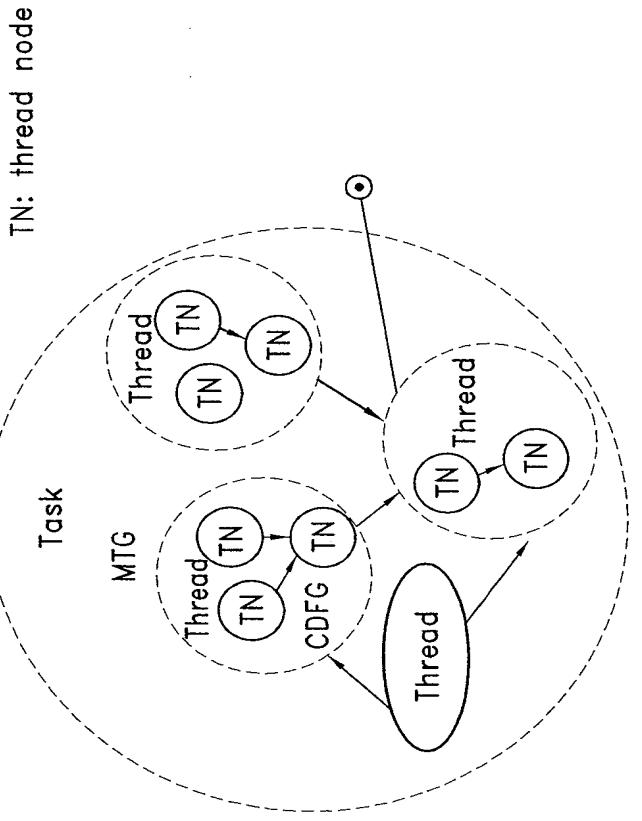


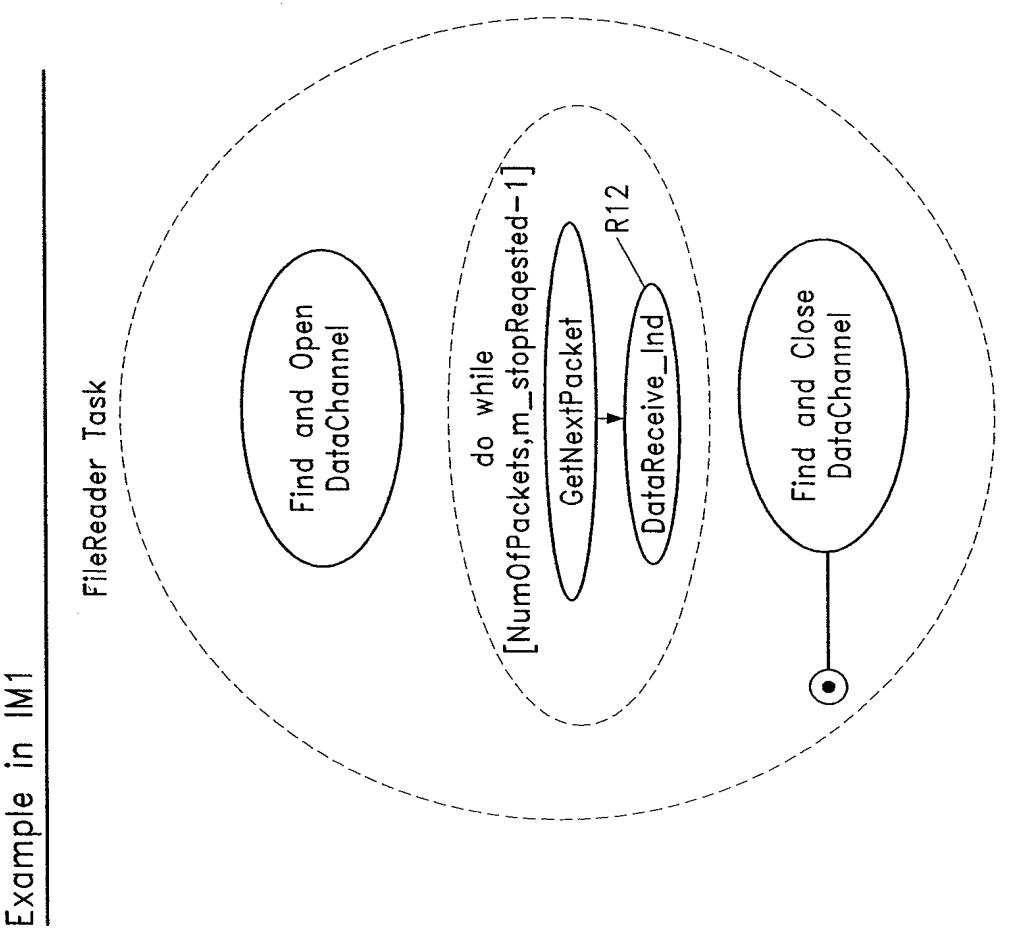
FIG. 15

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**FIG. 16**

Hide undesired constructs without trade-off to simplify the graph

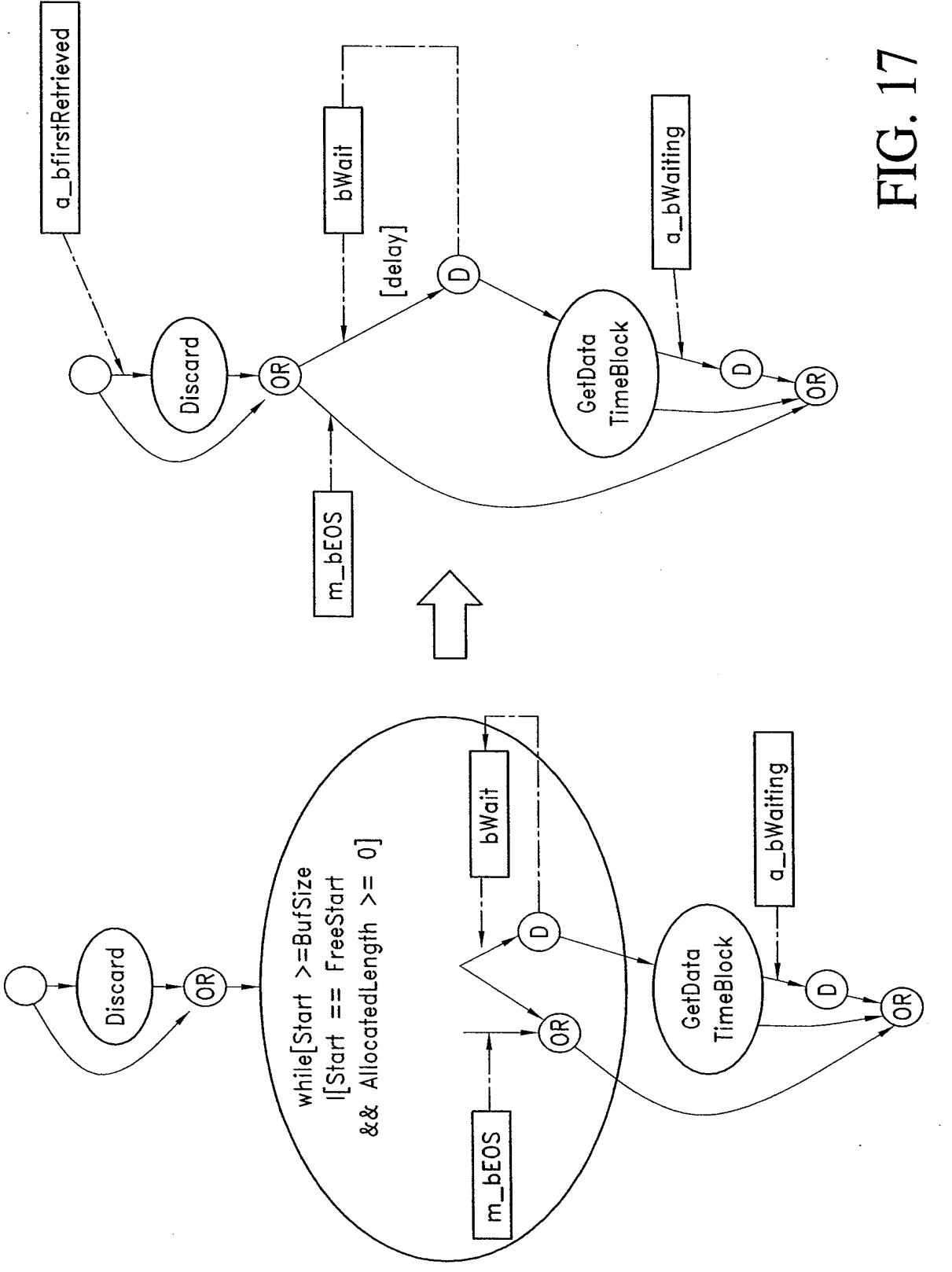


FIG. 17

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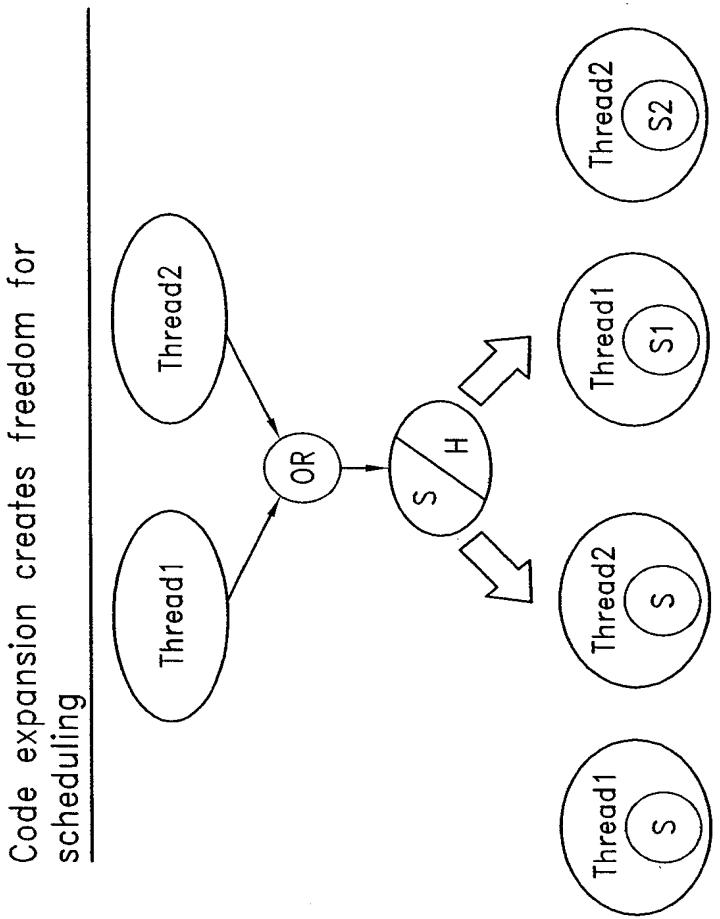


FIG. 18

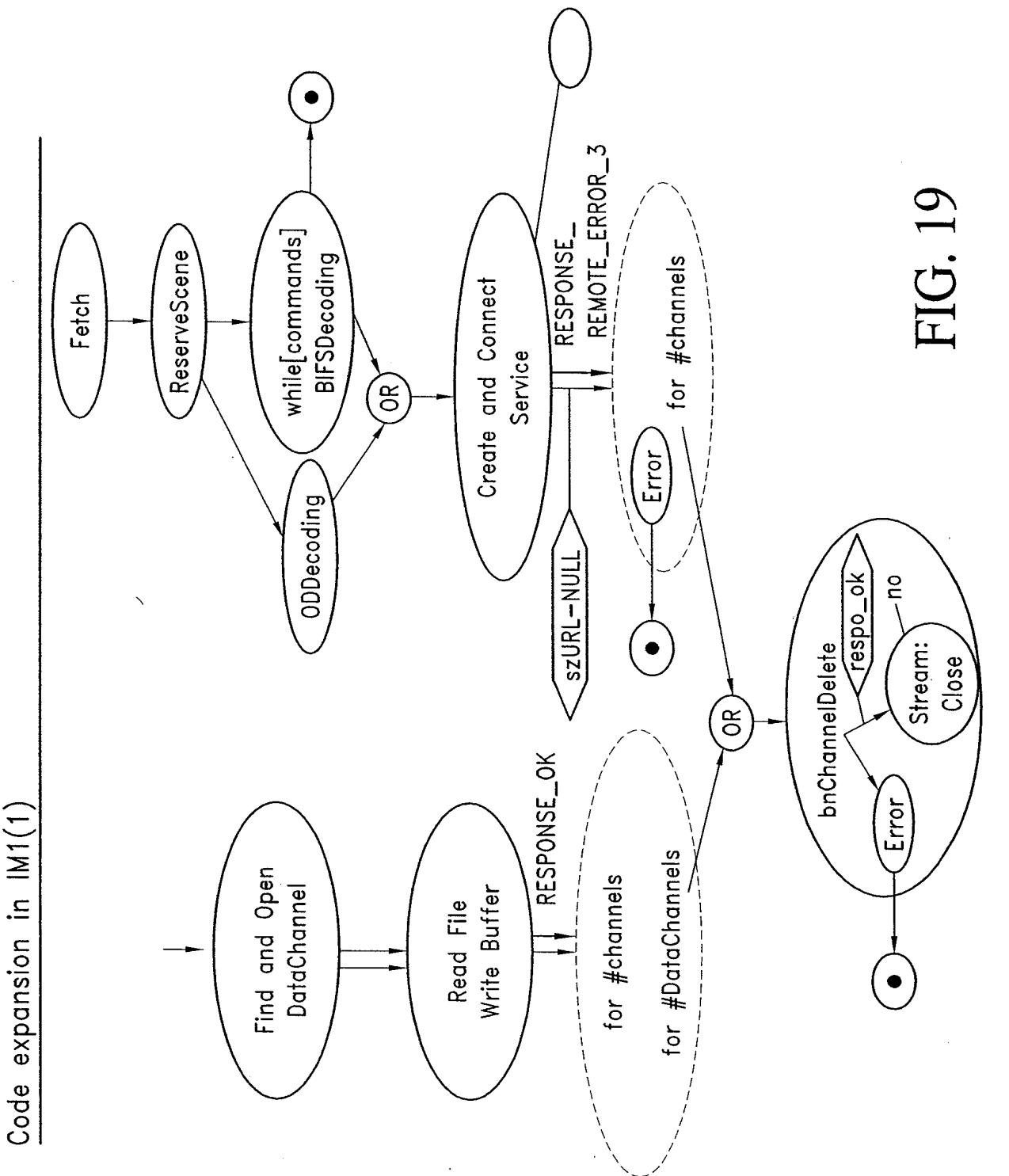


FIG. 19

Code expansion in IM1(2)

FIG. 20

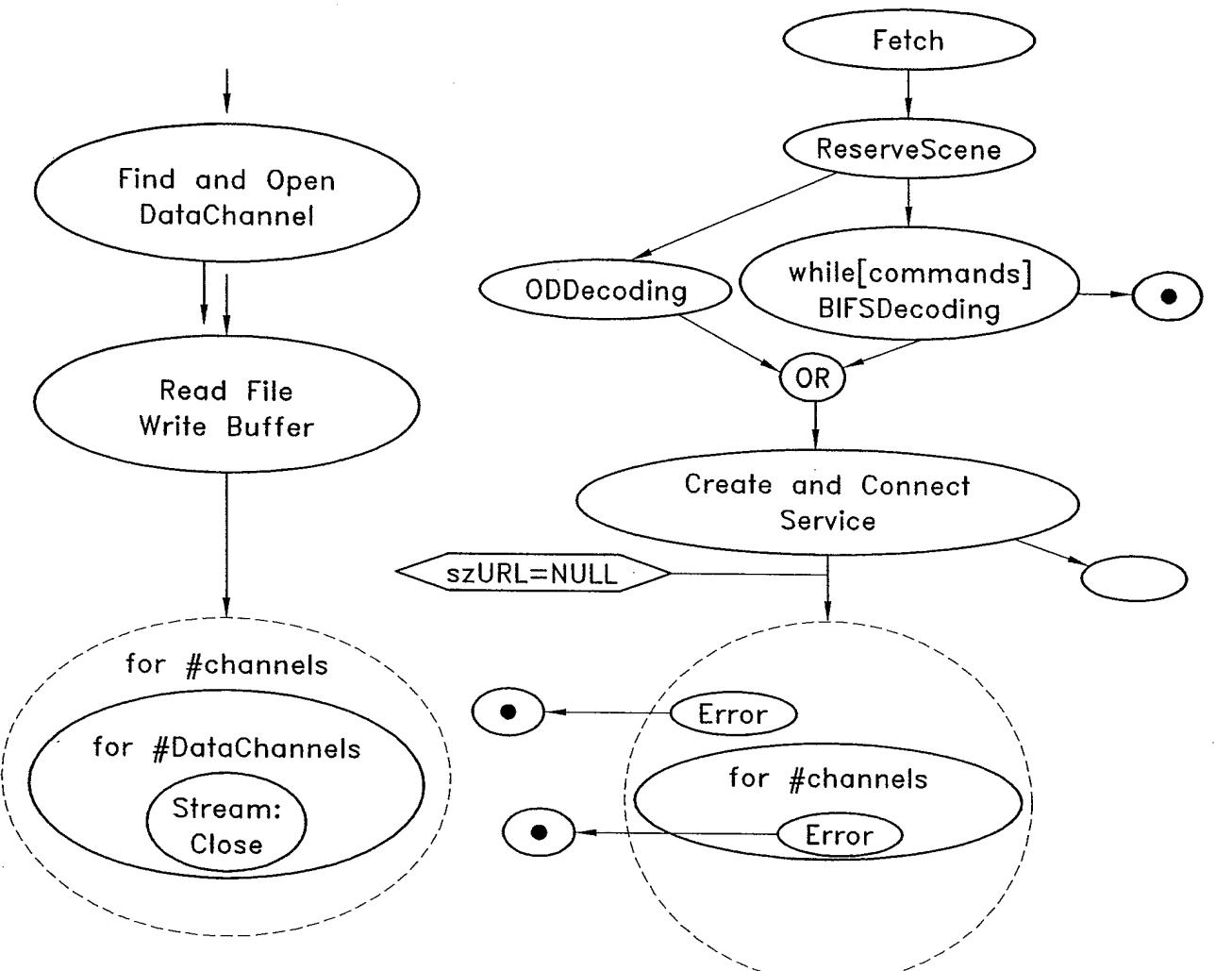
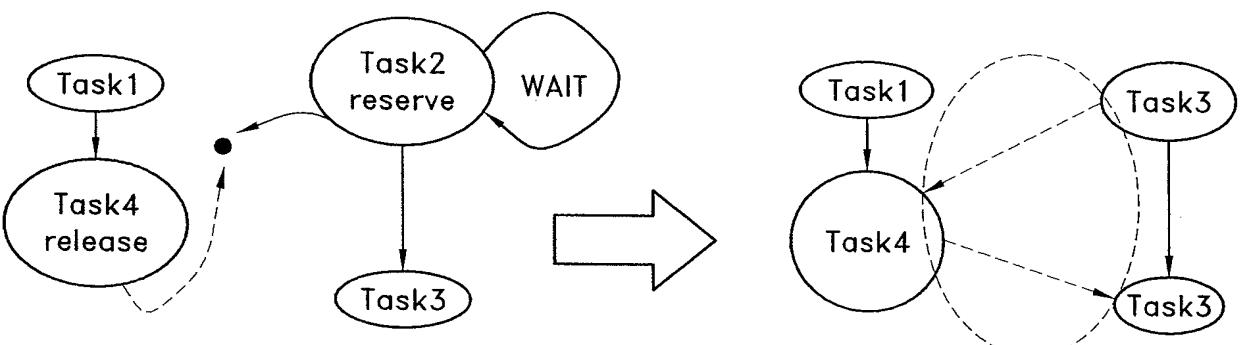
Remove constructs that make concurrency analysis difficult

FIG. 21



Trade-off complexity/freedom must be taken into account (1)

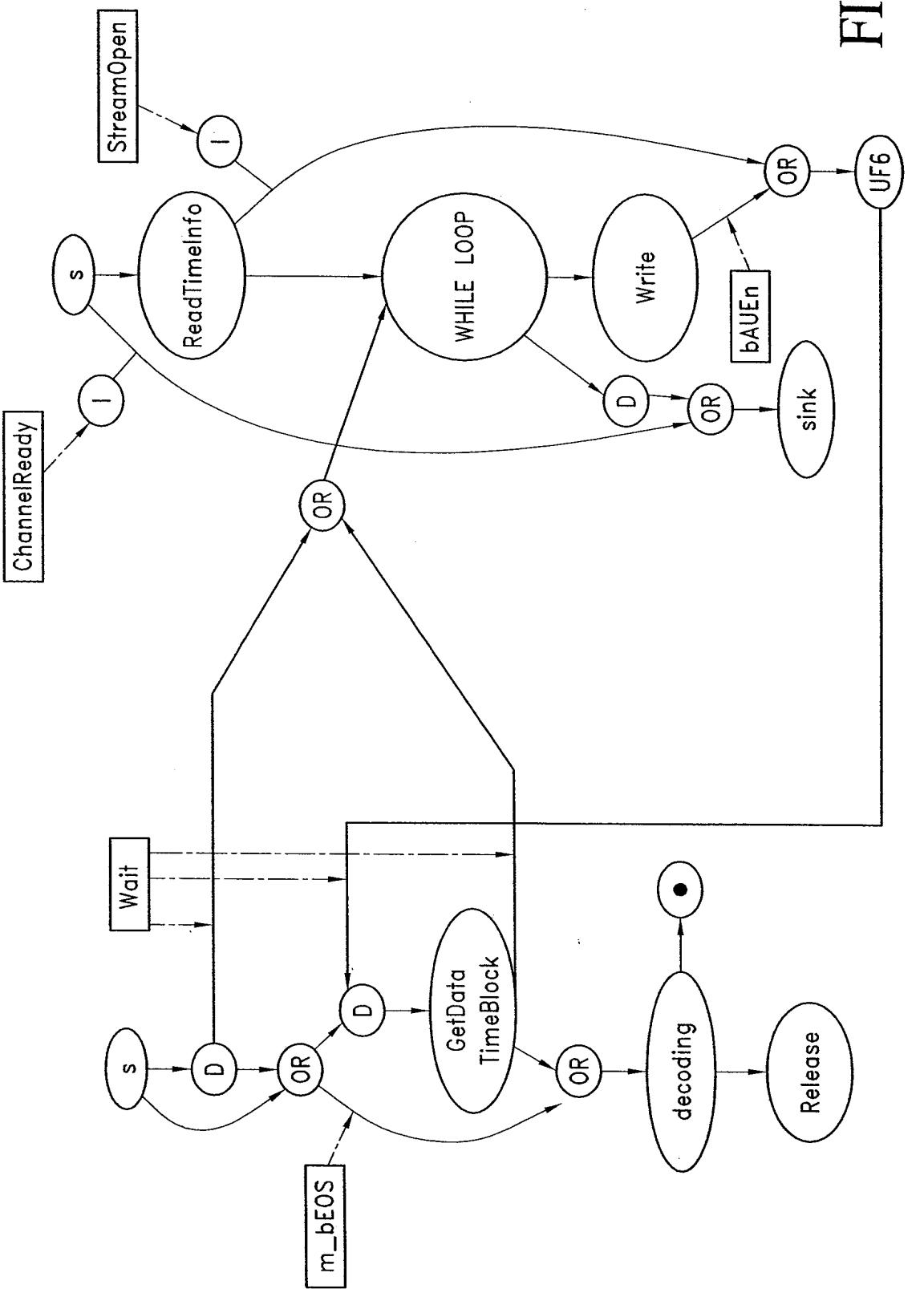


FIG. 22

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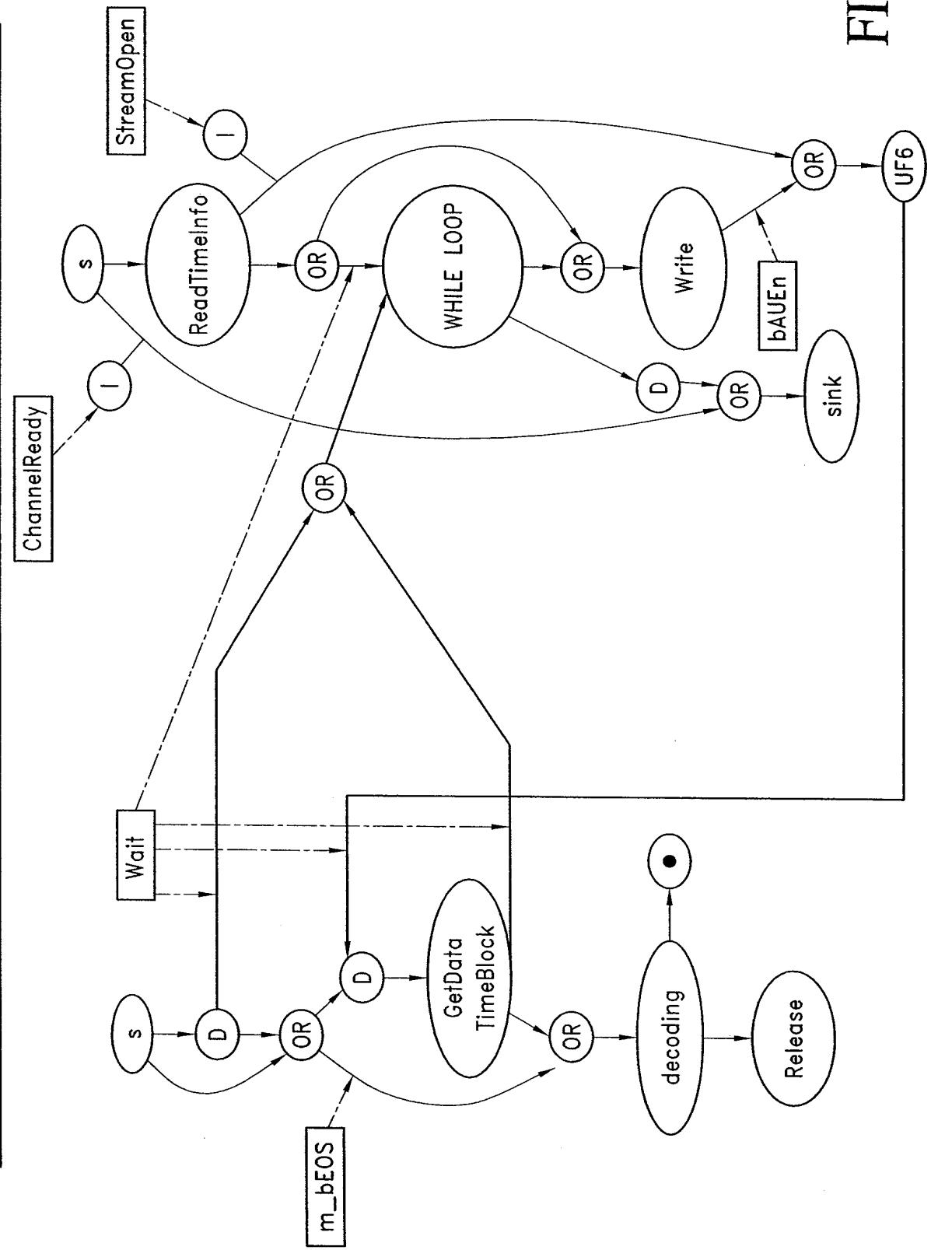
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FIG. 23

Trade-off complexity/freedom must  
be taken into account (2)



TASK CONCURRENCY MANAGEMENT DESIGN METHOD

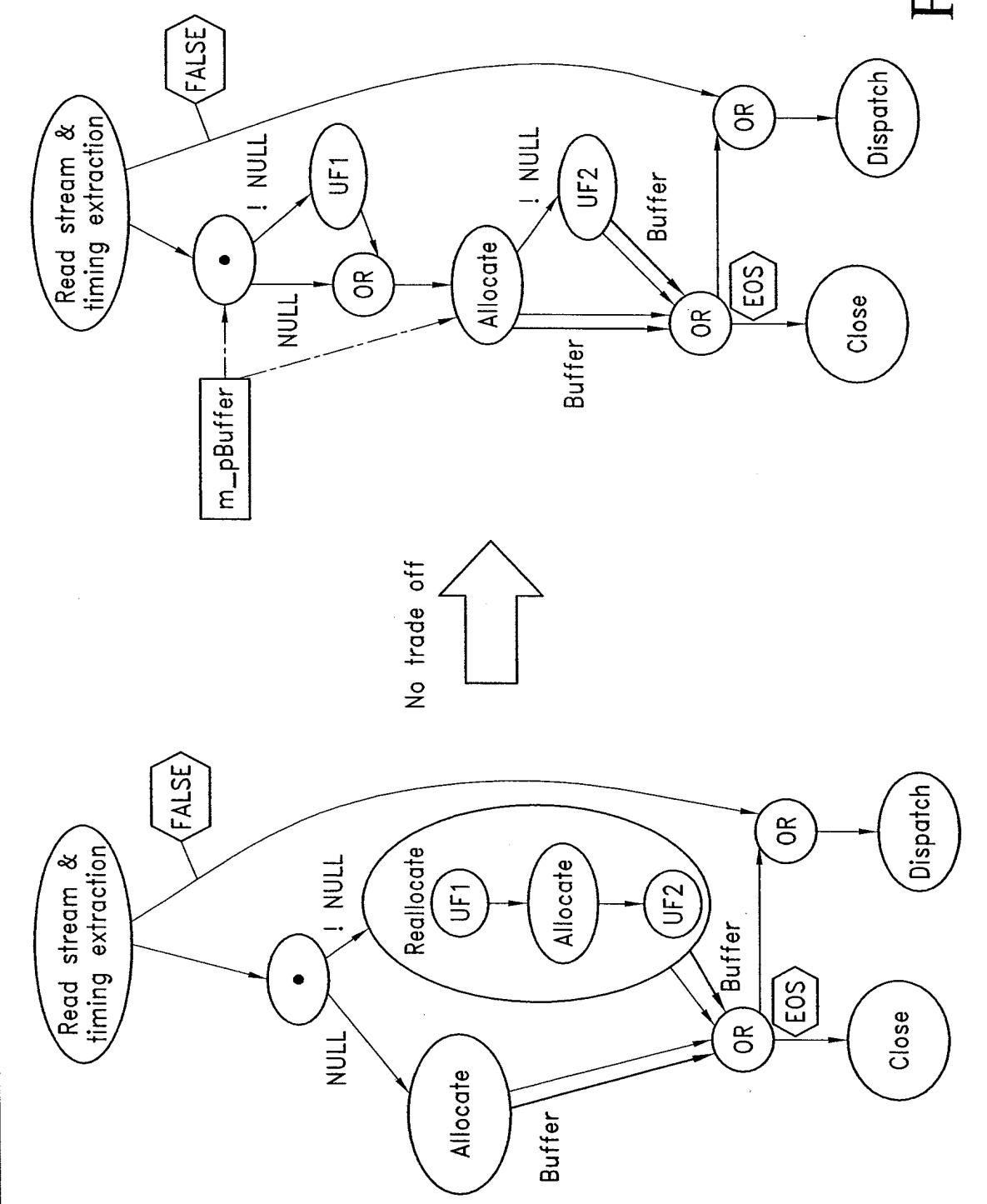
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FIG. 24

Transform constructs that cannot be removed



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Concurrency analysis focuses on the parallelism

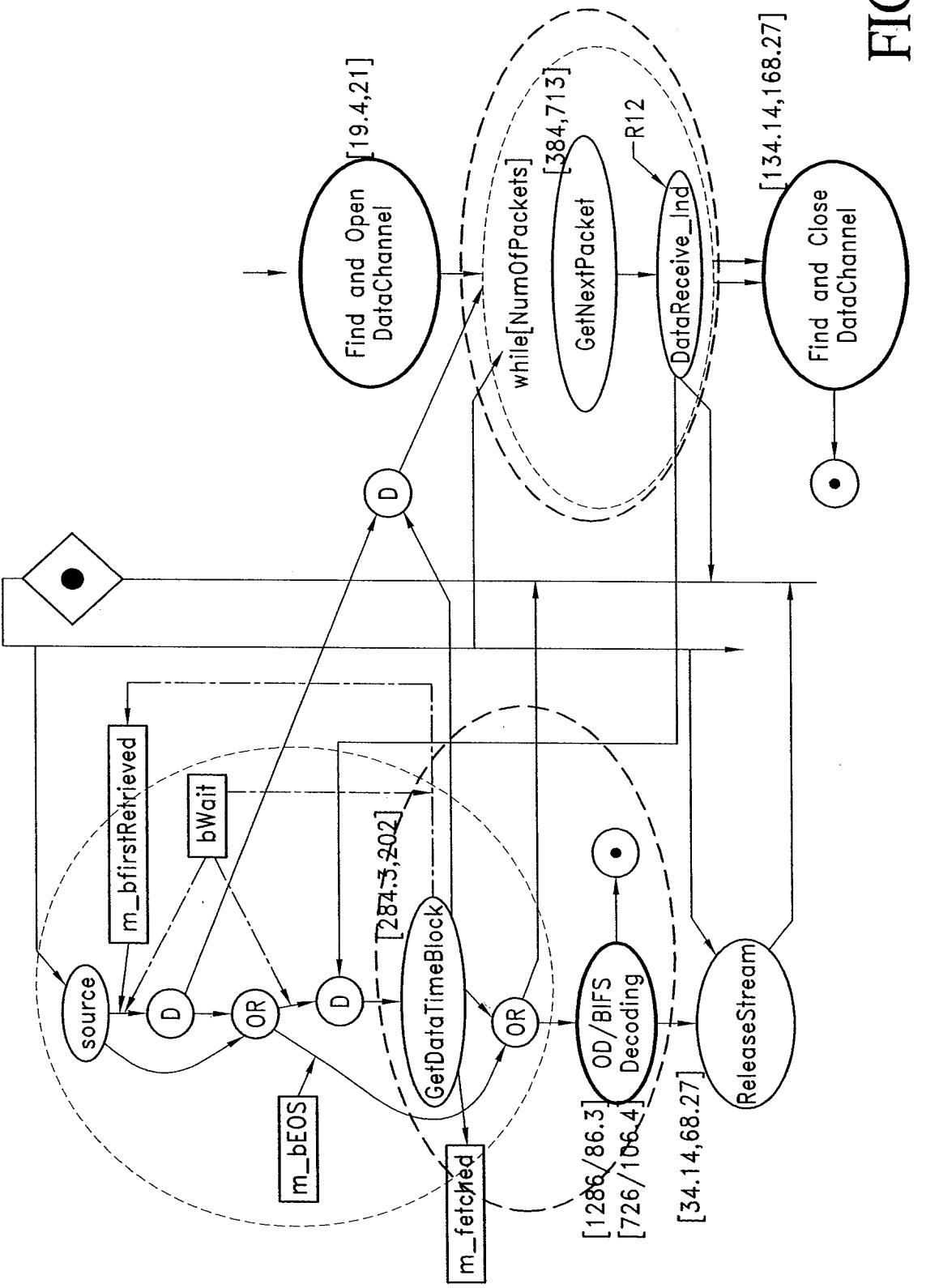


FIG. 25

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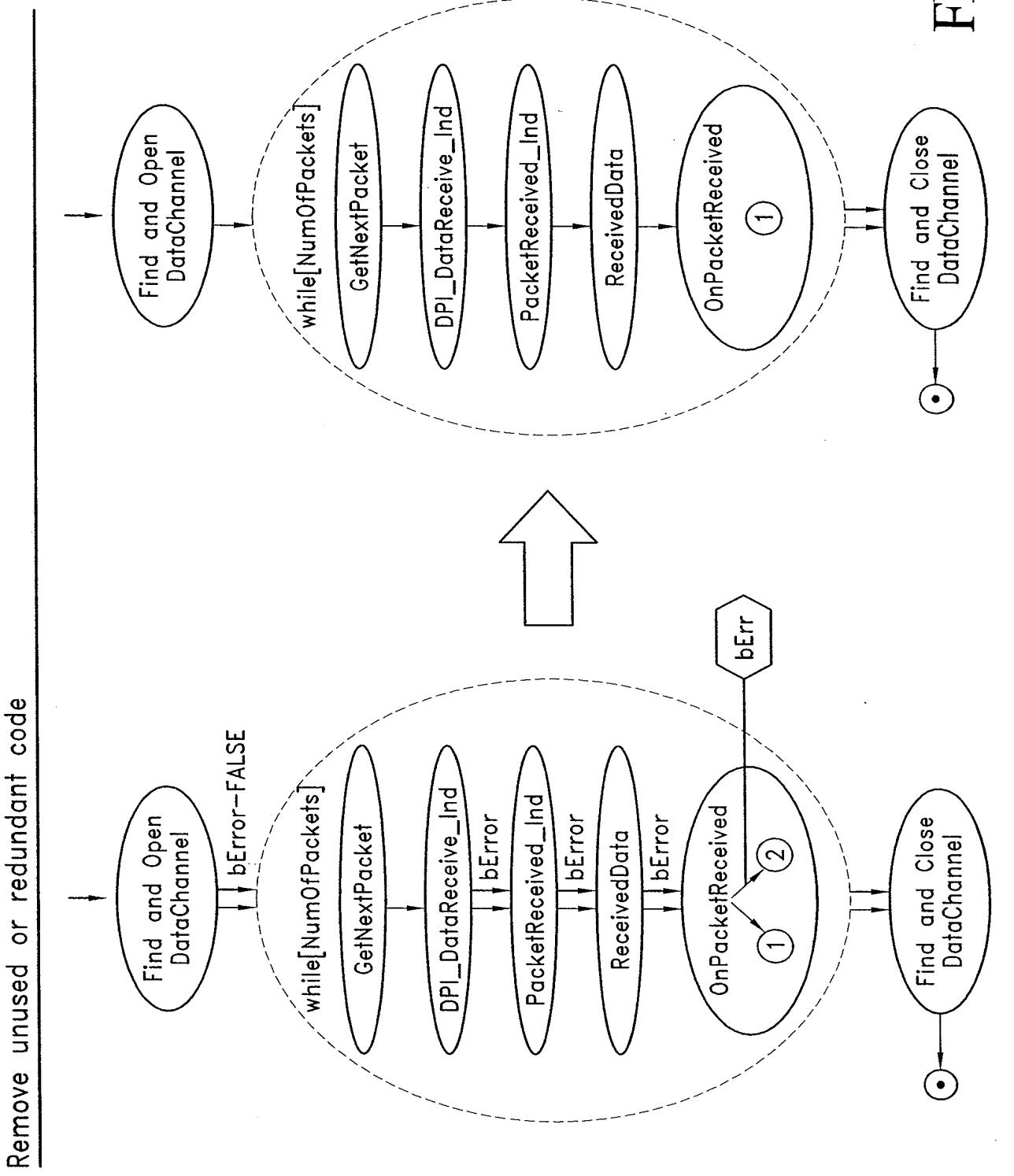


FIG. 26

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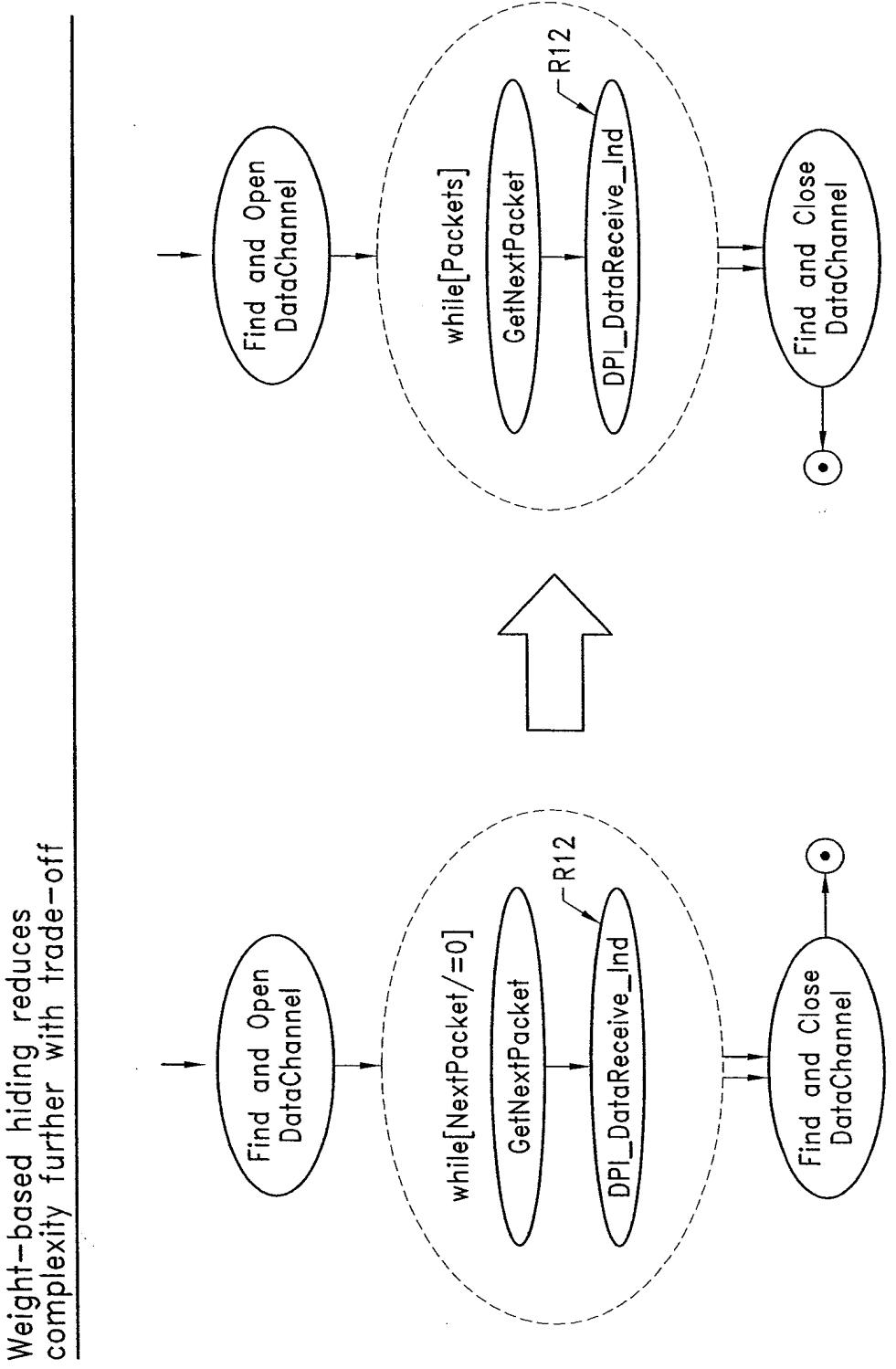


FIG. 27

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Partitioning clusters tasks with high interaction

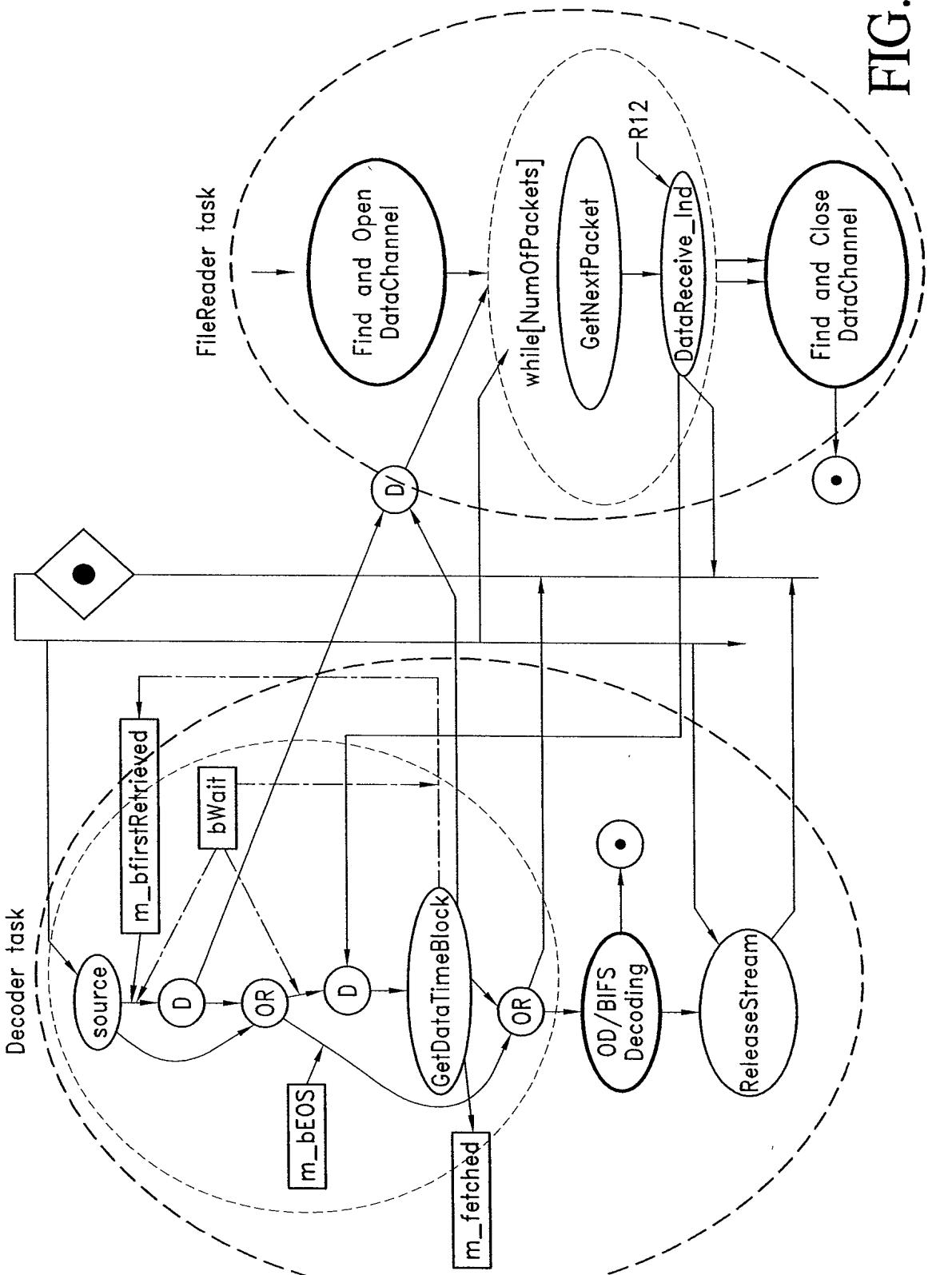


FIG. 28

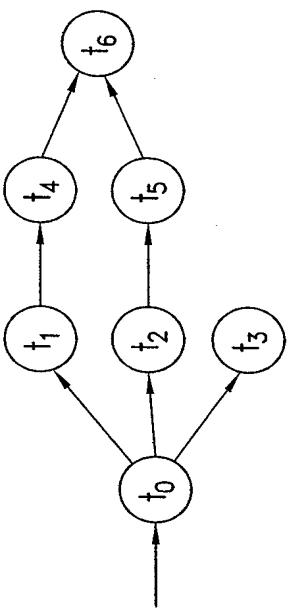


FIG. 29

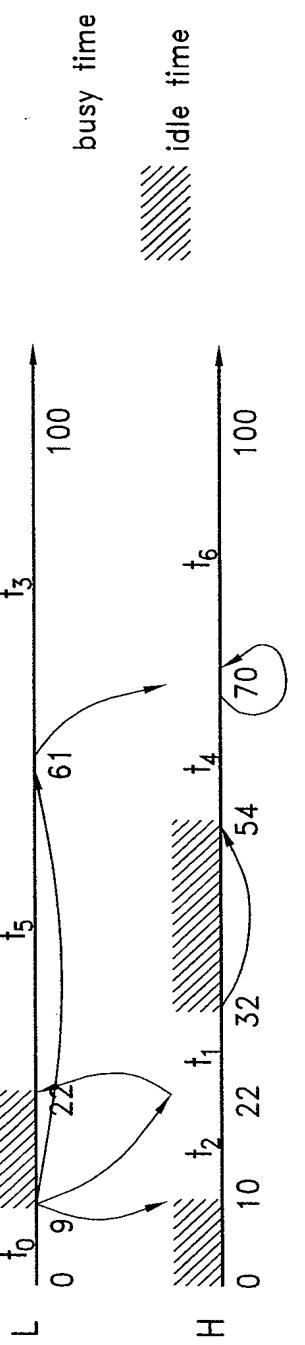


FIG. 30

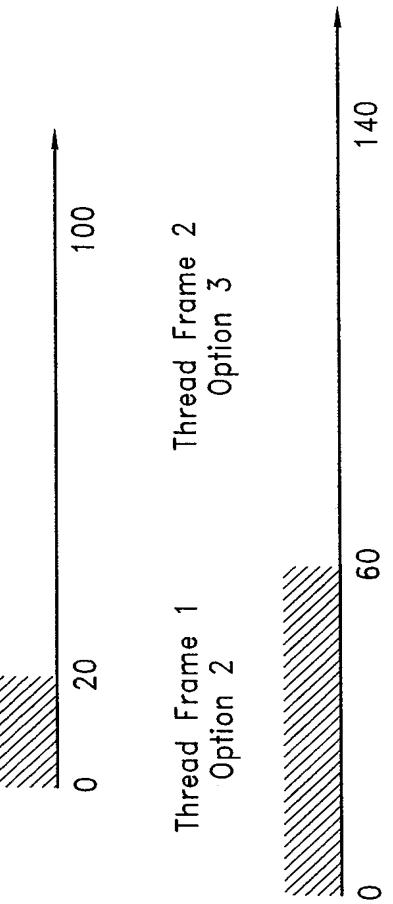
TASK CONCURRENCY MANAGEMENT DESIGN METHOD

Catthoor et al.

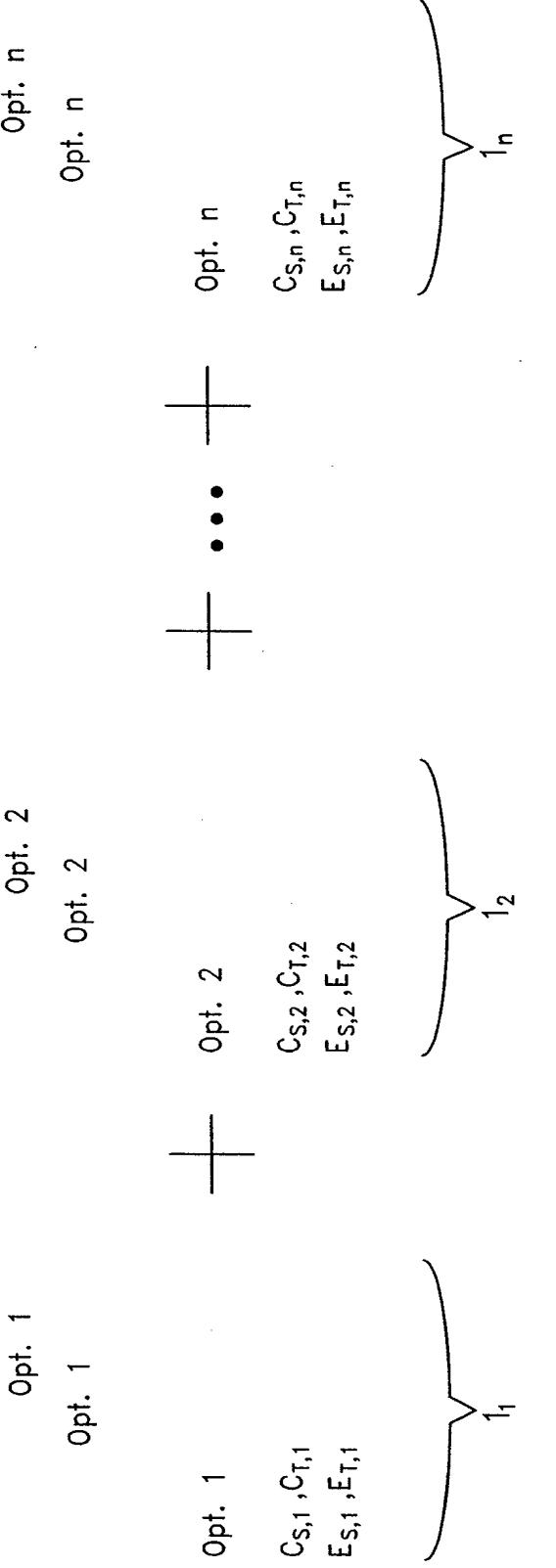
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**FIG. 31**



**FIG. 32**



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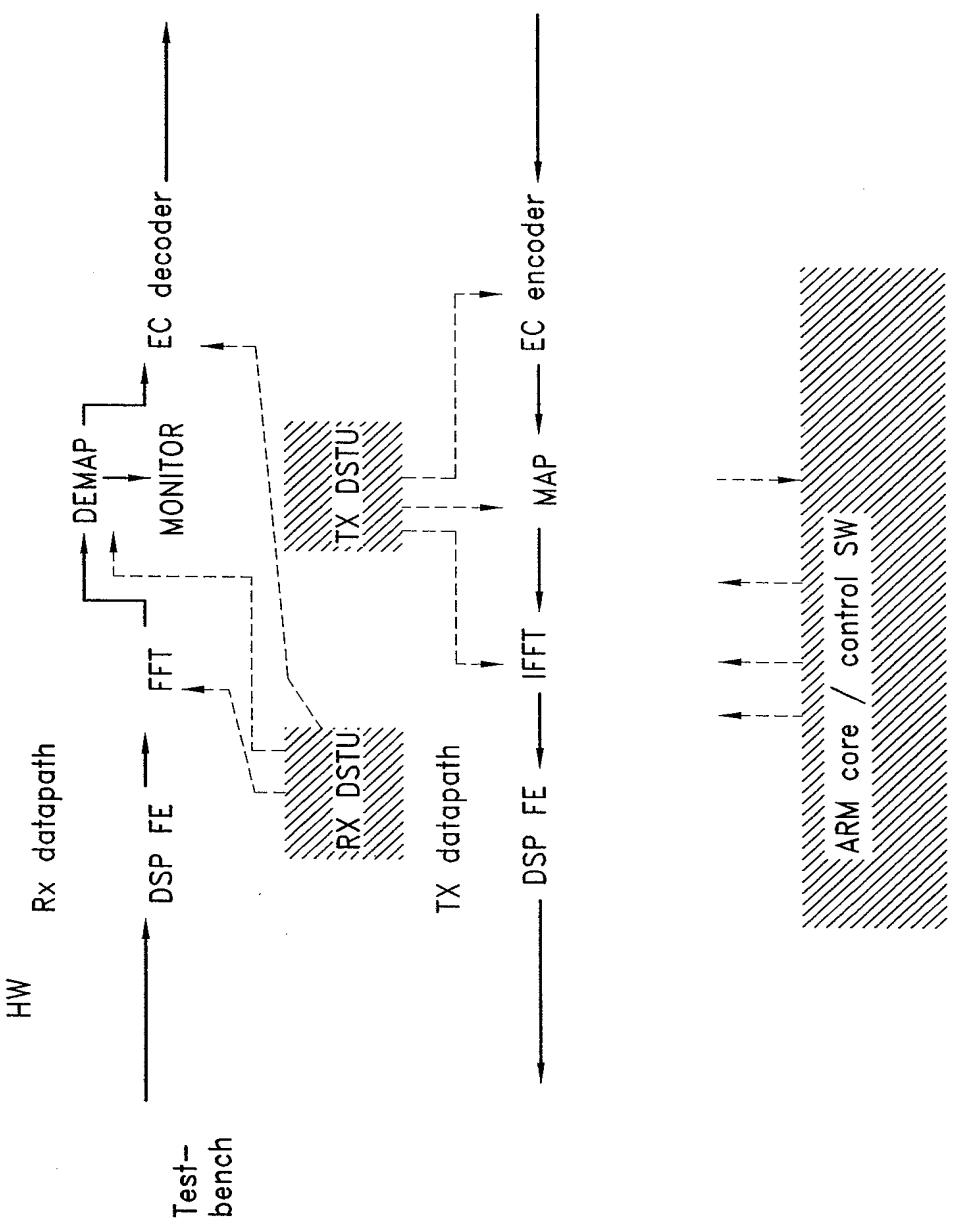


FIG. 33

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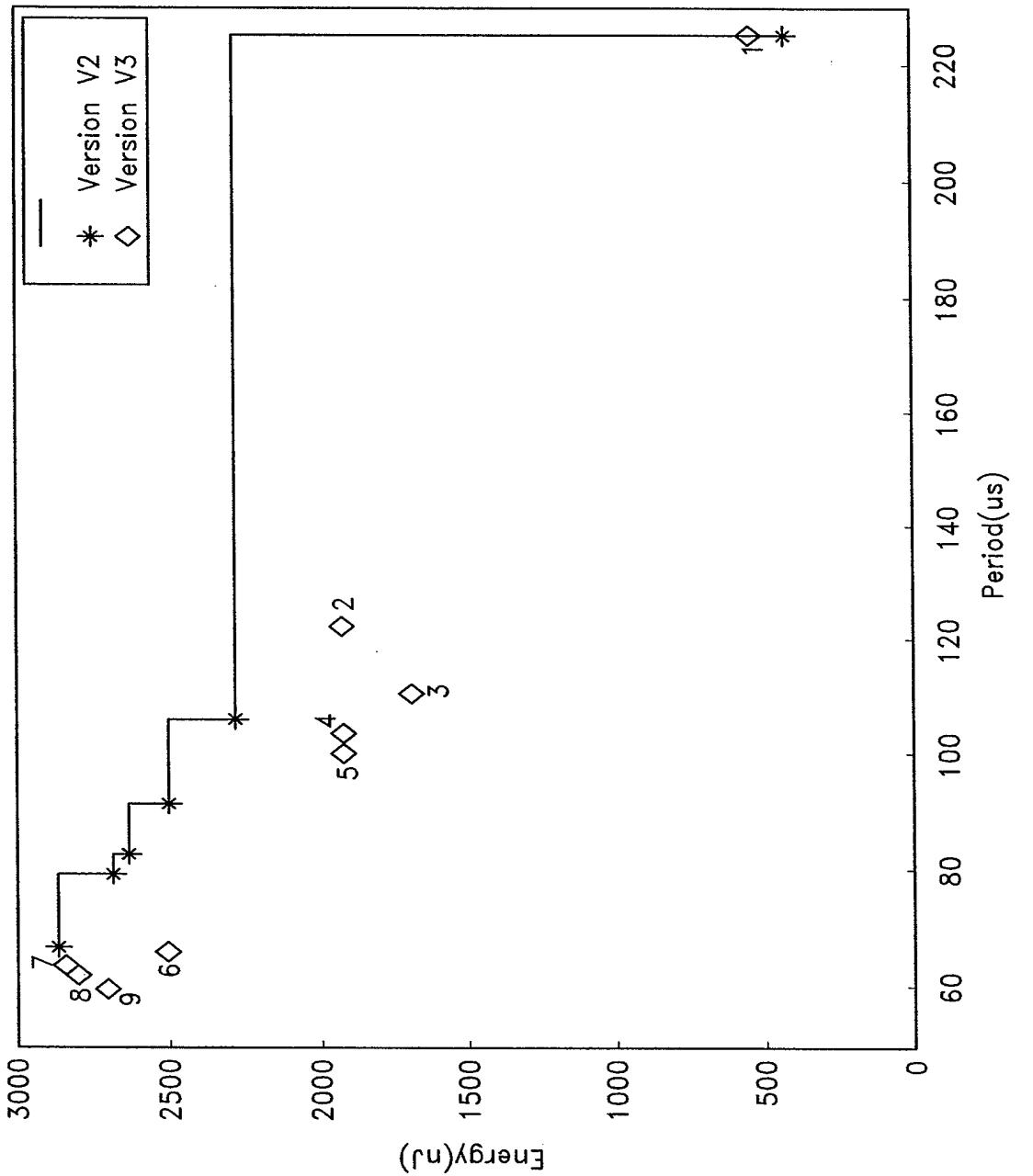


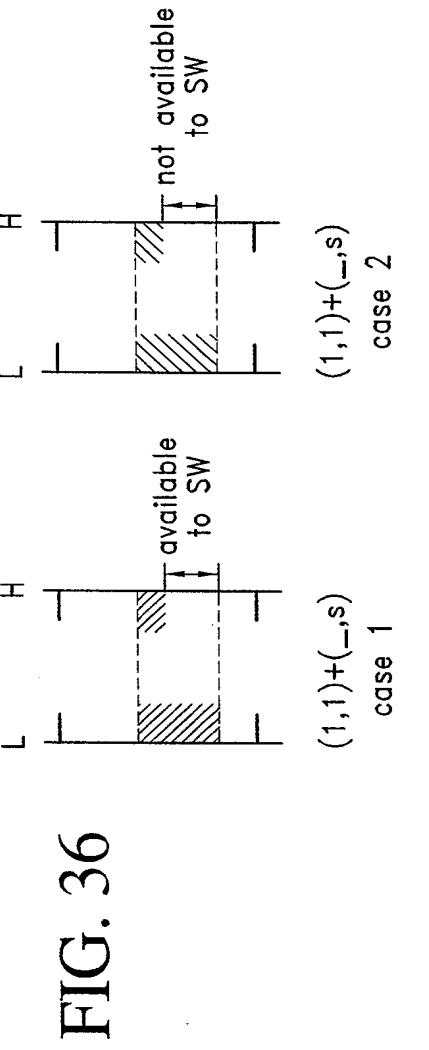
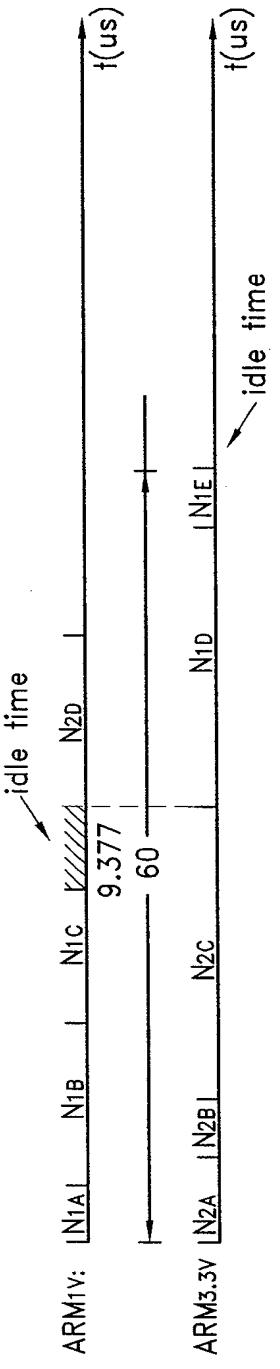
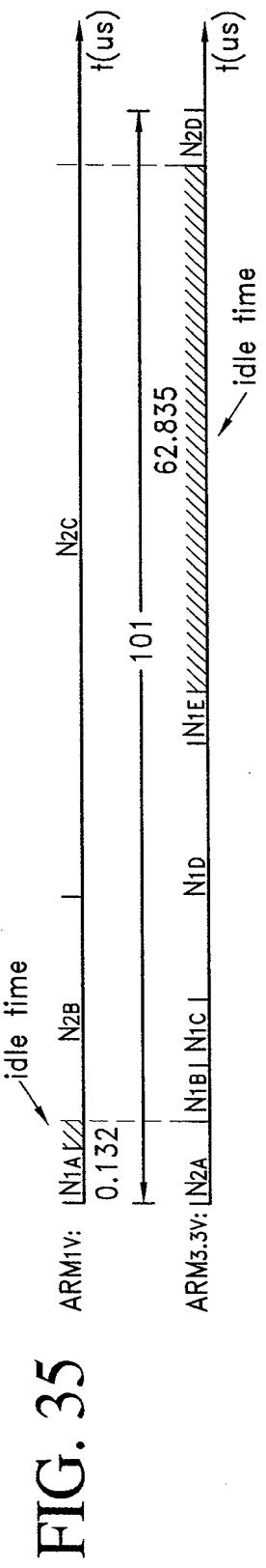
FIG. 34

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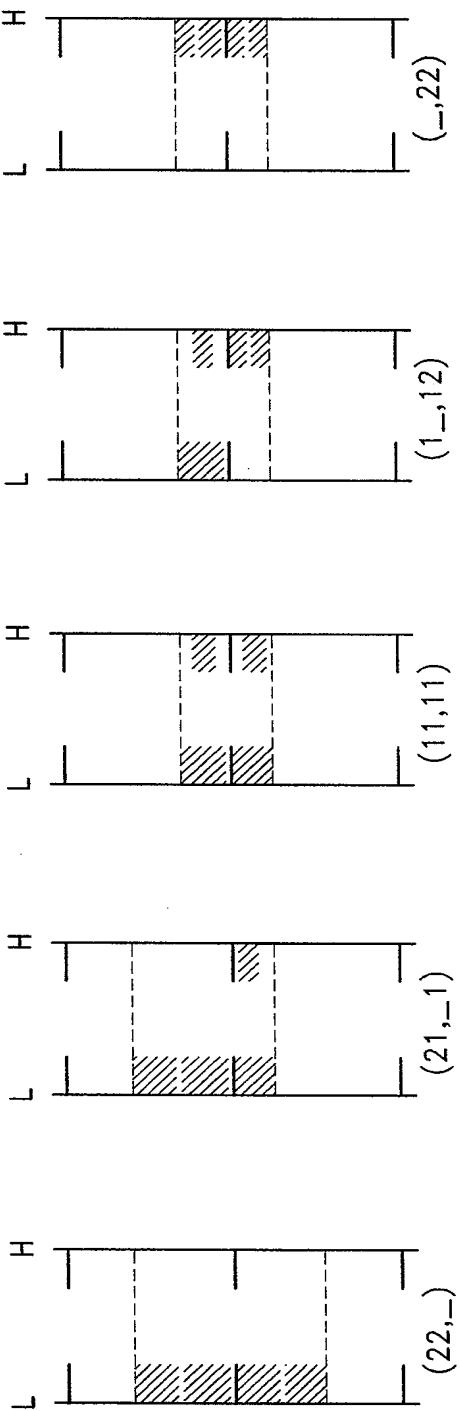


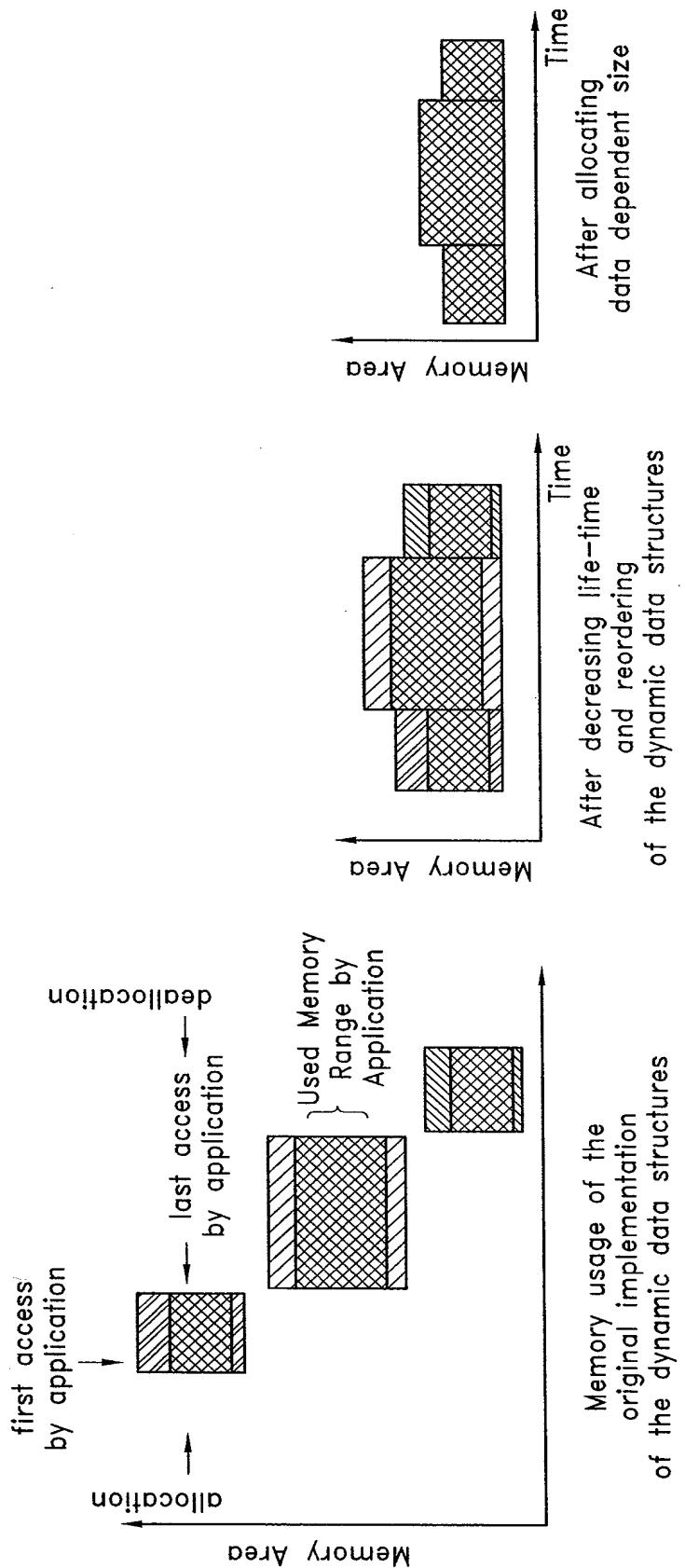
FIG. 37

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**FIG. 38**

TASK CONCURRENCY MANAGEMENT DESIGN METHOD

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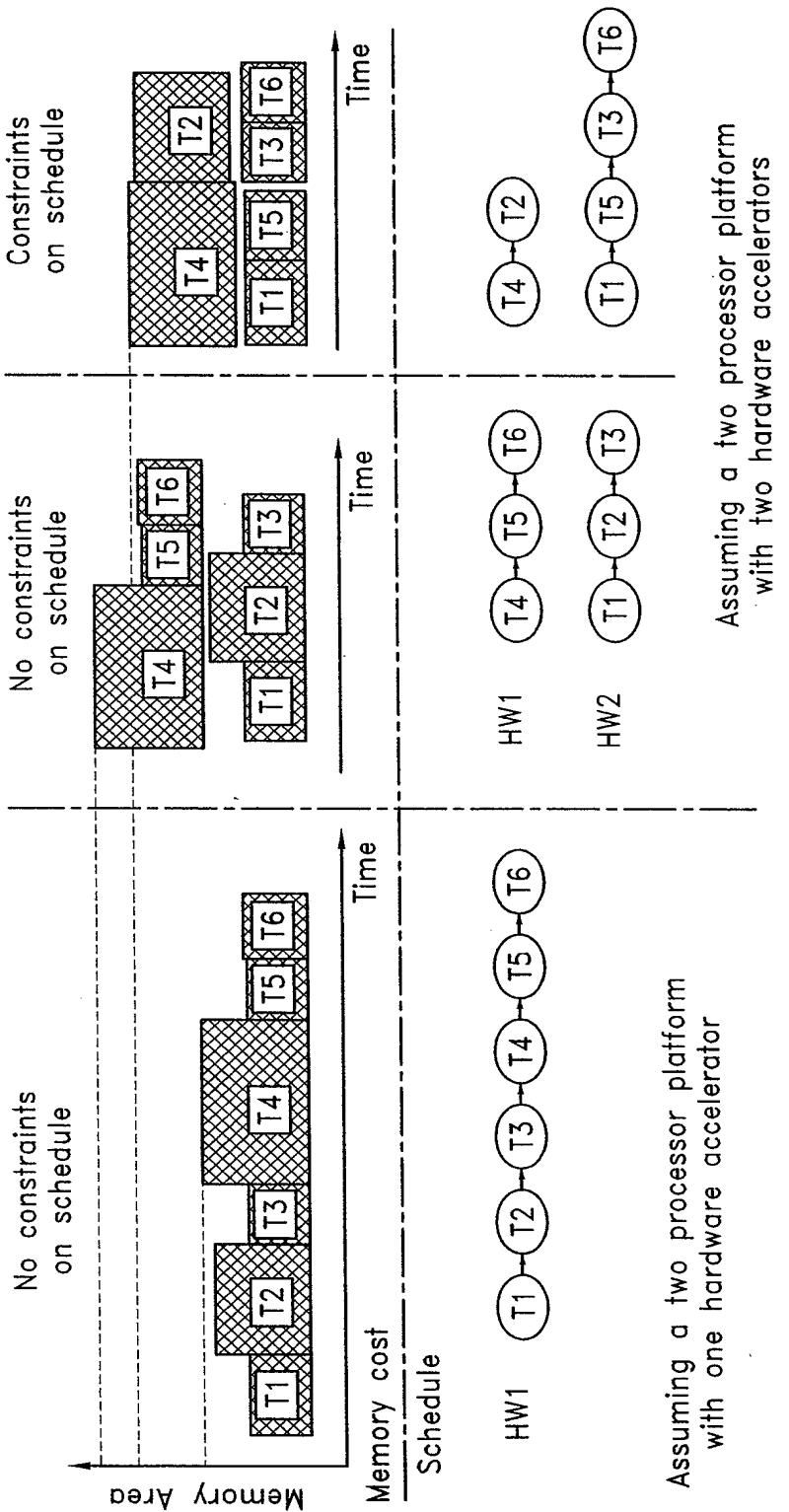


FIG. 39

**TASK CONCURRENCY MANAGEMENT DESIGN METHOD**

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	Execution Time						Energy Consumption							
	$t_0$	$t_1$	$t_2$	$t_3$	$t_4$	$t_5$	$t_6$	$t_0$	$t_1$	$t_2$	$t_3$	$t_4$	$t_5$	$t_6$
P1(H)	3	10	12	13	16	13	30	27	90	108	117	144	117	270
P2(L)	9	30	36	39	48	39	90	3	10	12	13	16	13	30

**FIG. 40**

	Thread Frame One			Thread Frame Two		
	opt.1	opt.2	opt.3	opt.1	opt.2	opt.3
Cycle Budget	20	60	100	40	60	80
Energy Cost	110	80	50	90	60	50

**FIG. 41**

Vdd	1 V	3 V	4 V	5 V
Frequency	10MHz	30MHz	40MHz	50MHz
Power (normalized)	1	27	64	125

**FIG. 42**

Task	4	5	6	7	8	9	10	11	12	14	15	16	17	18
Deadline (symbol)	128	96	128	128	768	256	128	132	16	64	16	2048	64	576
Ex. Time (ms)(10MHz)	3	3	3	21	240	9	60	12	3	21	3	864	18	285

**FIG. 43**

TASK CONCURRENCY MANAGEMENT DESIGN METHOD

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(L,H)		1,1	2,-	-,2
		s,-	-,s	s,-
Eq. $C_{S,i}(\mu s)$	166	624	102	690 230 564
$E_{S,i} + E_{T,i} \times 10^{-6}$	797	6247	230	6338 1364 6210

FIG. 44

(L,H)	1,1	2,-	-,2	Energy ( $\times 10^{-6}$ )
	s,-	-,s	s,-	s,-
task4		30		6900
task7	1	65	62	100315
task8	1	138	629	$1.73 \times 10^6$
task9		89		20470
task10		2	67	59
task11		3	11	18
				94960
task12		5	11	16154
task14		1	14	49
task16	1	2	855	1190
task17		3	8	53
task18	1	1	332	242
				$2.44 \times 10^6$
			Total	$1.222 \times 10^7$

FIG. 45

(L,H)		1,1	2,-	-,2
		s,-	-,s	s,-
Eq. $C_{S,i}(\mu s)$	166	498	102	306 188 564
$E_{S,i} + E_{T,i} \times 10^{-6}$	797	5113	230	2882 1322 6210

FIG. 46

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(L,H)	1,1	2,-	-,2	Energy ( $\times 10^{-6}$ )
S,-	-,S	S,-	-,S	S,-
task4		30		6900
task7	123	4	1	100273
task8	429	339		2.075x10 <sup>6</sup>
task9		89		20470
task10	10	117	1	606421
task11	12	19	1	112921
task12	14	1	1	17593
task14	32	30	1	186426
task16	467	1579	2	8.45x10 <sup>6</sup>
task17	40	22	1	147478
task18	4	570	1	2.92x10 <sup>6</sup>
Total				1.464x10 <sup>7</sup>

FIG. 47

(L,H)	22,-	21,-1	11,11	1-,12	-,22
S,-	-,S	S,-	-,S	S,-	S,-
Eq. $C_{S,i} (\mu s)$	204	612	268	804	332
$E_{S,i} + E_{T,i} (\times 10^{-6})$	460	5764	1027	7975	1594

FIG. 48

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(L,H)	22,--	21,--1	11,11	1,--12	---,22	Energy ( $\times 10^{-6}$ )
S,--	--,S	S,--	--,S	S,--	--,S	S,--
task4	15					6900
task7		4	69	1		100271
task8			213	168	1	$2.076 \times 10^6$
task9	45					20700
task10			2	5	57	606802
task11				6	9	112867
task12		2	1	5		17999
task14		1	1	14	15	186825
task16			234	787	1	$8.446 \times 10^6$
task17				20	10	1
task18				2	284	1
						1
						<b>Total</b>
						$1.464 \times 10^7$

FIG. 49

(L,H)	222,--	221,--1	121,1_1	12,1_2	-2,-2,2	
S,--	--,S	S,--	--,S	S,--	S,--	
Eq. $C_{S,i} (\mu s)$	204	816	268	1072	332	1328
$E_{S,i} + E_{T,i} (\times 10^{-6})$	588	13440	1612	18496	2636	23552

FIG. 50

TASK CONCURRENCY MANAGEMENT DESIGN METHOD

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**FIG. 51**

(L,H)	222,---	221,--1	121,1_1	12_,1_2	-2_,2_2	Energy ( $\times 10^{-6}$ )
	S,--	S,--	S,--	S,--	S,--	
task4	15					8820
task7		33	7	1	1	260100
task8	1	99	154	1	1	$3.93 \times 10^6$
task9	45					26460
task10		25		1	16	$1.09 \times 10^6$
task11		1	1	8		209548
task12	1		2	1		42852
task14		5	14	1	1	351156
task16		41	639	1	1	$1.52 \times 10^7$
task17		8	11	1	1	288408
task18			74		1	$5.23 \times 10^6$
					Total	$2.665 \times 10^7$

**FIG. 52**

(L,H)	2222,---	2221,--1	1221,1_--1	122_,1_--2	-22_,2_--2	
	S,--	S,--	S,--	S,--	S,--	
Eq. $C_{S,i} (\mu s)$	204	1020	268	1340	332	1660
$E_{S,i} + E_{T,i} (\times 10^{-6})$	716	26012	2065	35297	3710	44878

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(L,H)	2222,——	2221,——	1	1221,1—1	122—1,2	22—2,2	Energy ( $\times 10^{-6}$ )
	S,—	—,S	S,—	—,S	S,—	—,S	S,—
task4	15						10740
task7			1	33	7	1	441681
task8		1	1	57	132	1	$6.18 \times 10^6$
task9	45						32220
task10			1			24	7
task11				4	4		$1.67 \times 10^6$
task12		1		1		1	320700
task14			1	3	11	1	68584
task16				1	437	72	2
task17				6	5		$2.34 \times 10^7$
task18						46	454722
						98	$7.99 \times 10^6$
							Total
							$4.11 \times 10^7$

FIG. 53

FIG. 54

Case Number	1	2	3	4	5
Total Energy Cost	12.2	14.64	14.64	26.65	41.1

FIG. 55

Case Number	1	2	3	4	5
Total Energy Cost	31.2	34.6	34.6	39.1	41.1

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	1HW accelerator		2HW accelerators	
	Execution Time	Processor Energy	Execution Time	Processor Energy
0D	9ms	0.37mJ	9ms	0.37mJ
BIFS	24ms	0.98mJ	24ms	0.98mJ
Delivery	8.1ms	0.32mJ	16.2ms	0.64mJ
Wavelet	30ms	1mJ	30ms	2mJ
Total	30ms	2.58mJ	30ms	4mJ

**FIG. 56**

	1HW accelerator				2HW accelerators			
	Mem. Accesses	Mem. Size	Mem. Pre	Mem. Post	Mem. Accesses	Mem. Size	Mem. Pre	Mem. Post
0D	0.58k	10kB	0.58kB	0.58kB	10kB	0.58kB	0.58kB	0.58kB
BIFS	2.41k	41kB	2.41kB	2.41kB	41kB	41kB	41kB	41kB
Delivery	35.9k	35.9kB	12.4kB	71.8k	71.8kB	17kB	17kB	17kB
Wavelet	35.9k	35.9kB	12.4kB	71.8k	71.8kB	17kB	17kB	17kB
Total	74.9k	86.9kB	14.8k	146k	193kB	19.4k		

**FIG. 57**

	1HW accelerator		2HW accelerators	
	Energy Pre	Energy Post	Energy Pre	Energy Post
0.78mJ	0.16mJ	1.54mJ	0.19mJ	0.19mJ